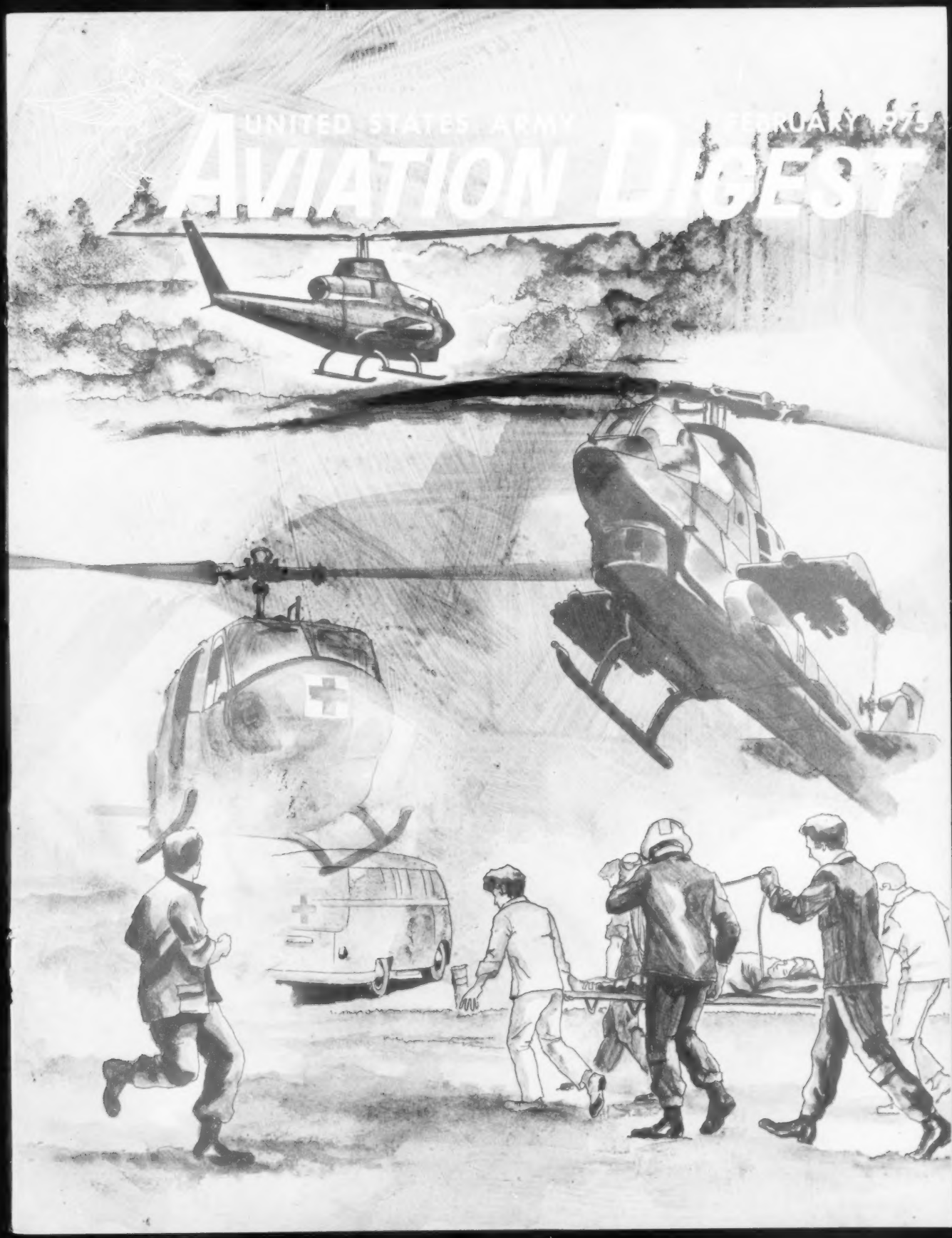
UNITED STATES ARMY
AVIATION DIGEST

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VANGUARD OF FREEDOM
BICENTENNIAL 1775-1975
UNITED STATES ARMY

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ABOUT THE COVER

Army aviation lends a helping hand to those in need through the MAST program on one front. On another, it develops new air assault tactics through maneuvers, training and testing to help ensure victory in the first battle of the next war. MAST articles begin on pages 1 and 4. Reforger 1974 covers tactical maneuvers, starting on page 6. See page 12 for the latest in training simulators and page 14 for a look at an unglamorous, but highly significant side of flight testing.
Cover by M. Dorough

The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine and other related data.

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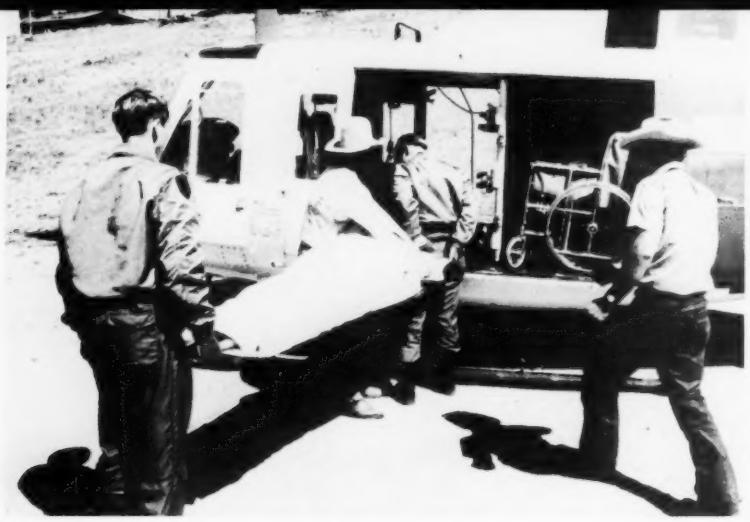
William L. Dickinson
United States Representative
Second District, Alabama

History of MAST Legislation

THE HELICOPTER was the most important and most used Army combat vehicle throughout the U. S. Army's 11 years of warfare in the Republic of Vietnam. Just as during the Korean war the helicopter performed admirably in the role of aerial ambulance, often delivering wounded soldiers to the field hospital moments after they were hit. While soldiers normally would progress through unit aid stations and the clearing stations further to the rear before they reached hospitals, the helicopter drastically revised the medical handling organization of the Army.

The same impact on our handling of civilian casualties here in Alabama and elsewhere can be gained from the helicopter. Accordingly, the Departments of Defense (DOD), Transportation (DOT) and Health, Education and Welfare (HEW) several years ago conducted a test using both Army and Air Force

An example of a MAST mission is shown below. A U. S. Army helicopter waits with blades turning as an accident victim is placed onto a stretcher. The victim, a 21-year-old coed, stepped into a snow hole at Glacier Basin in the snow-capped mountain region of Washington. Five minutes later the Army helicopter was on its way. On the scene and during the flight to a hospital the coed was treated by an Army medic



A woman being loaded into a helicopter for evacuation to a hospital for treatment of multiple sclerosis

helicopter units in traffic accident situations. The results clearly showed that both human suffering and fatalities could be reduced by responsive military helicopter evacuation along our highways and at other accident sites.

A corollary benefit of rapid evacuation of accident victims is the ability of the helicopter to expeditiously move seriously ill patients from one hospital to another. This permits a patient to quickly receive the specialized care that he requires without a time consuming and perhaps impossible ground ambulance trip.

In the fall of 1972 I was contacted by several people in the Second District (of Alabama) who were interested in having military air ambulance service provided from Fort Rucker, for the surrounding counties. This service incidentally has received the code name MAST, which means Military Assistance to Safety and Traffic.

The benefits of MAST were readily apparent. Not only could the military helicopter save civilian lives and reduce suffering of the injured but also its use in the MAST program had important military benefits. Military aviators could receive an operational mission—this means that the helicopter crews could be flying real, live missions instead of the training type activities which seem less real. The aid men would be working with actual casualties rather than mockups. The training value, therefore, would be substantial at little relative cost to aircraft that would be flying on a made-up training mission anyway.

About this same time an amendment was attached to the military authorization bill for the expansion of the MAST program, but it did not survive a House-Senate conference. When the 92nd Congress adjourned, legislation which had been introduced to expand MAST was defunct. Therefore, I decided to introduce a bill for this purpose myself when the 93rd Congress convened in January 1973. I did introduce a bill, patterned after previous legislation, and I contacted the Departments of Defense, Transportation and HEW, which all have a hand in the program, for further information on its operation with a view to rewriting the legislation in more precise terms.

After I had gathered quite a bit of information about the success of the MAST program at the five test sites, I made a statement on the floor of the House of Representatives to bring my bill to the attention of my colleagues. I then wrote the Chairman of the House Armed Services Committee, Honorable F. Edward Hebert, explaining the purpose of the bill and asking for hearings at the earliest possible date. The chairman answered that the committee was awaiting executive comment from the three departments responsible for the program, so I began at once to work on the departments to get the reports to the committee as soon as possible.

In the meantime I also set up a meeting with members of the staff of the Armed Services Committee to discuss the program and iron out some difficulties with the bill. This meeting was most helpful in deciding on new language for a MAST bill which would confine the program and keep it within the proper bounds to protect the military. I introduced the new bill on 18 April 1973.

Although the Armed Services Committee was in the middle of hearings on the Military Procurement Bill and other pressing matters, my efforts to coordinate with the committee were rewarded and the chairman agreed to schedule a hearing on the measure for 7 May 1973. I, of course, testified before the committee in behalf of the measure and answered questions concerning the bill. It was important to get the legislation passed as soon as possible because a similar but costly program was being considered in the Emergency Medical Services Bill before the House Interstate and Foreign Commerce Committee.

Unfortunately, a snag had developed concerning DOD's position on the bill. Both DOT and HEW reported favorably on the measure but deferred to DOD in effect. DOD was very much in favor of the legislation, naturally, since the Department had created the program in the first place. But the Office of Management and Budget (OMB) makes the final determination on department positions on legislation,

and OMB was opposed to the bill. The reasoning behind OMB's position was based on a desire to keep government expenditures from rising. I made every effort to convince the people who were in charge of writing the report that the bill was written so as not to lead to further government spending and thus be contrary to administration policy.

My efforts at that time were not successful, but the members of the House Armed Services Committee were able to see beyond OMB's position and the bill was reported by the committee with minor changes. I then was able to get the bill considered on the House floor on the Consent Calendar and the measure was passed by unanimous consent without debate on 21 May 1973.

The problem of getting the bill considered in the Senate Armed Services Committee was a major one in view of the unfavorable report from the Defense Department (via OMB). So I set up a meeting with key Senate Armed Services Committee staff members, DOD personnel and my office to discuss possible strategy. The Senate Committee is often slow to move on minor legislation, and it was decided that the most effective approach would be a floor amendment in the form of my bill to the Military Procurement Act which would be considered on the Senate floor in September.

While these negotiations were going on I also went before the House Rules Committee to block action on the Emergency Medical Service Bill which had been reported from Interstate and Foreign Commerce with the expensive "MAST-type" program in it. I was successful in getting this provision deleted from the bill before it went to the House floor for action.

The DOD report was still a problem, and I continued to discuss the matter with OMB. In early September, shortly before the Senate was to consider the Military Procurement Act, I chaired a meeting in my office with OMB staff members, DOD personnel in charge of the legislation, and a White House liaison official. We were finally able to convince the OMB people that MAST is not in conflict with administration policy, and it was agreed at that meeting that OMB would okay a favorable report by DOD with further minor changes in the bill.

Evacuation directly to the hospital grounds, avoiding city traffic, is often possible

On the strength of this agreement Senator Strom Thurmond of South Carolina offered my bill as an amendment to the Military Procurement Act on 26 September 1973 and the amendment was agreed to. Since there were a number of differences in the House and Senate versions of the Military Procurement Act, including the MAST provision, a conference committee was appointed to resolve the differences.

Although I expected no problem in having the MAST provision included in the conference report since the legislation already had been passed by the House of Representatives, I contacted the House conferees to be sure they were aware of the provision and would vote to include it, which they did. There were several other provisions debated in the conference which were controversial, however, and action on the conference report took several weeks. Consequently, the measure was delayed further but finally enacted into law on 16 November 1973.

Alabama gains directly from the initiation of Project MAST. Its counties surrounding Fort Rucker and Fort Benning, GA, now are being served by highly professional, well-trained Army helicopter crews. Lives already have been saved. Fort Rucker alone has provided MAST evacuation of 66 seriously ill or injured patients since the program was implemented at that installation on 1 April 1974. The same service is being instituted around many other military posts throughout the United States. One fringe benefit of Project MAST is that the military and civilian communities will be very closely linked and the image of our Armed Services thereby enhanced.

As the sponsor of this legislation I am extremely pleased that the bill has become law and particularly proud that it only took 10 months from the time of introduction to enactment. However, much more than that I am grateful that a successful program of cooperation between the military and local citizens has been allowed to be expanded so that more lives can be saved and our air rescue units can get better training. It is a privilege to be part of this project.

MAST

1974

Several months ago when plans were being made for this MAST issue of the DIGEST, it was decided to do a roundup story of the more interesting or important missions. However, we soon learned that these missions are difficult to characterize. The commanding officer of one of the units illustrated the problem by saying, "When I'm pushing one of those birds it's interesting and when there's a sick person onboard it's important." This article covers missions that illustrate the significance of the MAST program

High risk newborn

Photo by SSG Burchfield

A 1969 SAFETY study conducted by the Departments of Defense, Transportation, and Health, Education and Welfare resulted in the Military Assistance to Safety and Traffic (MAST). Military helicopters and paramedical personnel were authorized to assist in civilian medical emergencies (see November 1973 DIGEST for other articles pertaining to MAST).

The first phase of a test program was started with three Army and two Air Force units participating. By 1974 it was determined that the program was feasible and—with the consent of Congress—enlarged to include 16 Army units and four Air Force units. From the period 1 January 1974 to 1 January 1975 MAST units had flown 1,335 missions, carrying 1,329 patients while flying 3,322.2 hours.

MAST missions generally fall into one of two categories: field pickups or hospital transfers. Field pickups usually are those made without benefit of landing sites. The landing area usually is marked by smoke, flares, colored articles of clothing, lights, or anything which might attract the crew's attention. If the pilot determines the area to be unsuitable for landing, he may elect to pick up the patient from a hover or use an internal rescue hoist. However, the hoist is used only in cases of life or death or over water where no suitable alternative exists to effect the evacuation.

Hospital transfers may include prematurely born children, critically injured or ill patients, human organs for transplant or blood.

The 507th Medical Company (Air Ambulance) located at Fort Sam Houston, TX, reports that interhospital transfer of critically injured or ill patients comprises a majority of its MAST missions. An example of these missions is the transfer of a 5-year-old boy who had been bitten by a rattlesnake. The transfer was from Seguin, a town east of San Antonio, to Santa Rosa Medical Center. The small boy was in dire need of specialized treatment and a lifesaving antivenom. Rapid response by the MAST crew to this emergency is credited with saving the boy's life.

Snakebite victim

Onsite pickups of highway accident victims comprise another major category of the 507th's MAST missions. As an example, a compact car and a pickup truck collided on an isolated highway some 40 miles northwest of San Antonio, resulting in critical injuries to both of the teenage occupants of the small car. A highway patrolman radioed for a MAST helicopter. It was dispatched and evacuated both patients to San Antonio within 30 minutes after the accident. Injuries to one of the victims included a fractured pelvis and leg and multiple internal injuries. The second youth had massive internal and head injuries.

Because of the Institute of Surgical Research of the Brooke Army Medical Center at Fort Sam Houston another frequent mission involves patients suffering burn injuries. A 76-year-old man from New Braunfels, a town 25 miles north of San Antonio, received second and third degree burns over 50 percent of his body when a small kerosene stove he was attempting to light exploded. The man was stabilized at the New Braunfels hospital while a MAST helicopter and crew was enroute to transfer him to the Institute of Surgical Research.

Occasionally the 507th Medical Company is called upon to perform a mission because of the versatility of the helicopter and the skill of its pilots and crewmembers. A mission of this type involved a painter who had been working inside a water tower in downtown San Antonio. He was overcome by fumes and became unconscious inside the 175-foot-tall tower. Attempts by the fire department to lower him from the tower were fruitless. A MAST helicopter was summoned and arrived with a rescue hoist. An extremely low ceiling, poor visibility and high

Continued on page 18

THE SCENE IS the rolling Bavarian hills of south central Germany; the month, October; the action, Reforger '74. For the first time since the Reforger (Redeployment of Forces from Germany) exercises began in 1969 Army aircraft were employed extensively in an antiarmor role (see "Reforger I," May 1969 DIGEST).

In previous Reforger exercises Army aviation assets were used for command and control for ground units or to carry maneuver umpires. Last year only a platoon-sized element of attack aircraft participated.

Much as had occurred in the Republic of Vietnam in the 1960s, the timely arrival of Army aviation assets changed the tide of battle over the Bavarian countryside in Reforger '74. The major difference though is that the skies overhead in Bavaria were not full of helicopters. The attack helicopters operating in Bavaria used nap-of-the-earth (NOE)/terrain flying techniques to creep along the shadows of the river valleys and used natural terrain to conceal themselves from enemy radar and visual observation.

Reforger '74's chief participating units consisted of the "aggressor" Orange Forces—the 1st Armored Division based at Ansbach, West Germany, and the 4th Canadian Mechanized Brigade Group of Lohr, West Germany. The Blue Forces, coming to aid the "invaded" country, were primarily the 1st Infantry Division deployed from Fort Riley, KS, and the 30th Panzer Brigade of Ellwangen, West Germany.

The Blue and Orange Forces were assigned European-based Army aviation elements. Each received an attack helicopter company; an assault helicopter company; a platoon of CH-54 Flying Cranes; a platoon of CH-47 Chinook medium lift helicopters; and an air cavalry troop.

For Reforger '74 the Orange Forces massed at the Autobahn which forms the eastern edge of the training area and the Blue Forces assembled west of the training area boundary.

Umpires were attached to each participating tactical element. When a battle was imminent the umpires from each tactical element that was about to engage would meet and measure the firepower of the opposing forces. It then was decided who would win the engagement on the basis of firepower, expected casualties, etc. Next, the combat units were allowed to maneuver for tactical employment and defense. The arrival of U. S. Air Force tactical air support and Army aviation attack helicopters added significant firepower to the battle.

For the first 3 days Orange Forces controlled the maneuver area and had aggressed some 70 kilometers to the west of the Autobahn. The Blue Forces then, simulating deployment from the continental United States, started counterattacking with superior forces. That's when my unit, the 334th Aviation Company (Attack Helicopter), started earning its keep. We were supporting the Orange Ground Forces when they were in retrograde. More than once our attack helicopters arrived on-station and moved into firing positions in time to change the tide of battle. (Despite the fact that I've been talking and writing about NOE/terrain flying for years, I'm afraid I had been sort of a nonbeliever. But now I'm NOE qualified and a believer—IT WORKS! On several occasions my aircraft was undetected within 1,000 meters of advancing Blue Forces.)

For the exercise we simulated AH-1Q TOW Cobras with our attack helicopters (we'll receive our TOW Cobras later) and used our OH-58 Kiowa helicopters for scouts. We adopted a Fort Hood, TX, procedure and established a *battle captain,* who was in the lead scout. The battle captain was in charge of the mission. He did all the coordinating with friendly forces and positioned the attack helicopters into firing positions—providing them with firing azimuths, range and targets. (For training purposes we changed battle captains daily to give all aviators a chance to lead the mission.)

In some exercises the attack helicopters worked with friendly armored elements or other friendly forces and had to identify both Blue and Orange Forces, sometimes providing surveillance and delaying actions while their allied forces maneuvered for blocking actions or counterattacks. In other tactical situations the attack helicopters worked independently engaging and delaying the Blue Forces while the Orange massed assets for maneuver.

The airborne eyes of our scout aircraft were used to locate the advancing counterattacking Blue Forces. Tactical terrain flying techniques were used to get to the area where the advancing Blue Forces were reported. We used natural terrain features, houses, villages, barns and even corridors through artillery barrages for cover and concealment, unmasking only briefly to search for the advancing tanks, air defense units and mechanized vehicles.

When our scouts and battle captain made contact with the enemy forces they moved the attack helicopters into firing positions, still using the terrain mask for cover and concealment. After firing we would again mask and move to new firing positions or new targets. (Once you've engaged an armored unit you've buttoned it up, slowed it down and triggered its air defense elements into looking for you. So, depending on your mission and expendability you might just as well move to another target.)

Throughout the exercise we tried different aircraft mixes. We found a battle captain could control up to

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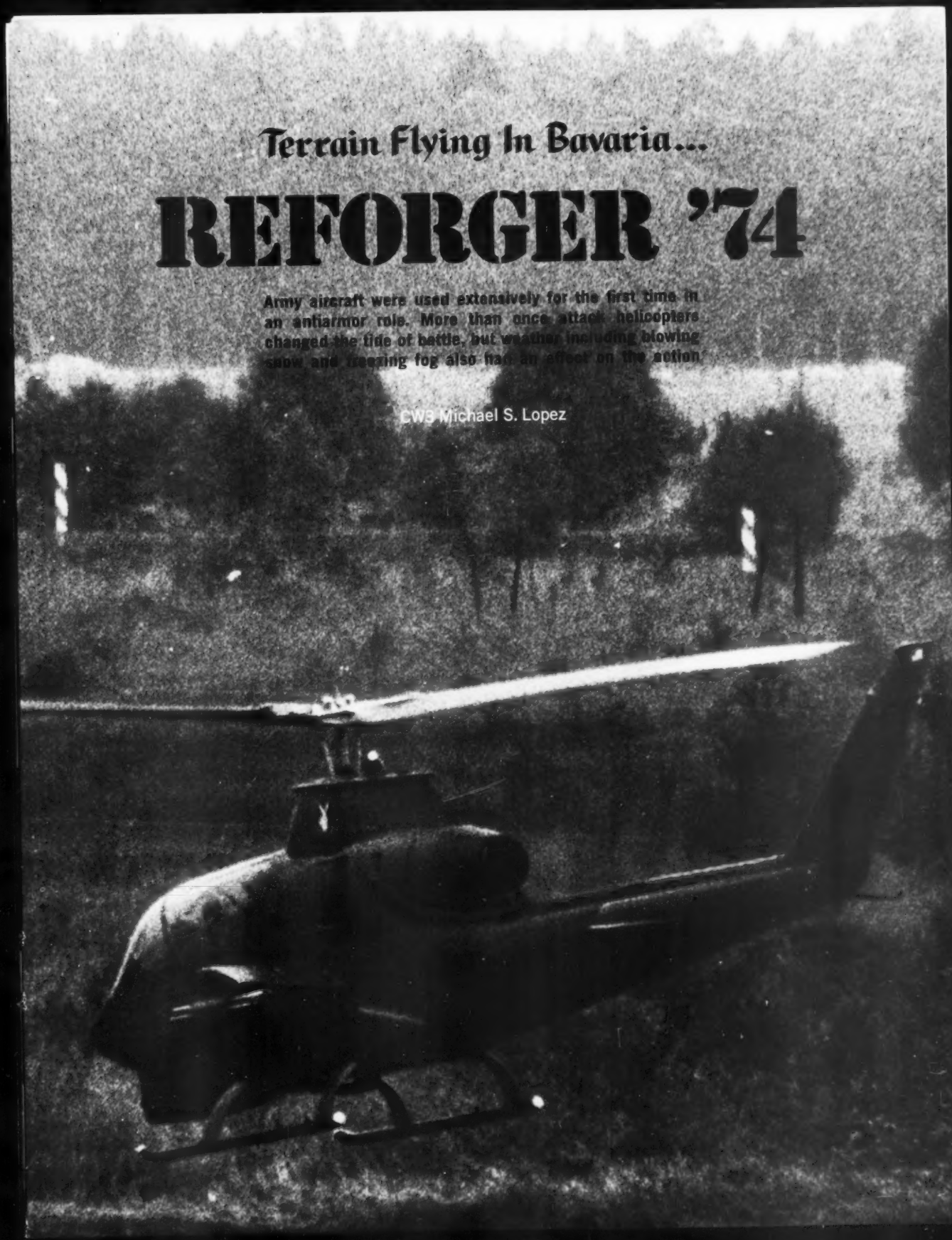


Terrain Flying In Bavaria...

REFORGER '74

Army aircraft were used extensively for the first time in an antiarmor role. More than once attack helicopters changed the tide of battle, but weather including blowing snow and freezing fog also had an effect on the action.

CW3 Michael S. Lopez

PROJECT RAVE

CW3 Charles M. Tidey
U. S. Army Electronics Command
Fort Monmouth, NJ

One pilot controls the helicopter from the cargo compartment while two safety pilots keep watch up-front. CARGO COMPARTMENT? Yep, that's what it's all about in this joint service research project

PROJECT RAVE, part of the U. S. Army Electronics Command's (ECOM, Fort Monmouth, NJ) low level night operation (LLNO) test program, is investigating electronic equipment requirements for conducting night and/or adverse weather operations at nap-of-the-earth (NOE) altitudes.

RAVE, which stands for Research Aircraft for Visual Environment, consists of flying a U. S. Marine Corps CH-53A helicopter as an avionics laboratory test-bed. The CH-53 is one of the few single rotor helicopters in production capable of carrying all of the experimental test equipment and data collection systems needed. The helicopter has been modified (figure 1) with a third pilot's cockpit installed in a completely enclosed portion of the cargo section. The cyclic, collective and antitorque pedals are connected via push-pull tubes and bellcranks into the aircraft's normal control tubes. An electrical/hydraulic disconnect system has been installed to allow fail-safe disconnection of the third pilot's controls in case of an emergency.

The third pilot station was in-

stalled as the surest means of controlling the pilot's visual environment. The pilot has no outside reference except that which is presented to him by the inflight engineer at the data collection console located in the aft portion of the aircraft's cargo section. Also, this control of the environment at the third pilot station allows performance of all nighttime maneuvers during daylight hours, thereby increasing the safety aspect of the test program. Two safety pilots occupy the normal pilot/co-pilot positions during all flights.

The third pilot cockpit has changed configurations as the test program progressed. During Phase 1 the display for the third pilot station consisted of three video monitors equipped with Farrand pancake windows (figure 2) which provided the pilot with up to 180 degrees horizontal field of view (FOV) of the outside terrain. It also had provisions for a helmet mounted display (HMD) with head tracker, similar to the one that was conceived for the AH-56A Cheyenne. This HMD had a 40 degree diagonal FOV and with the head tracker/turret combination provided a capability for viewing 180 degrees horizontally.

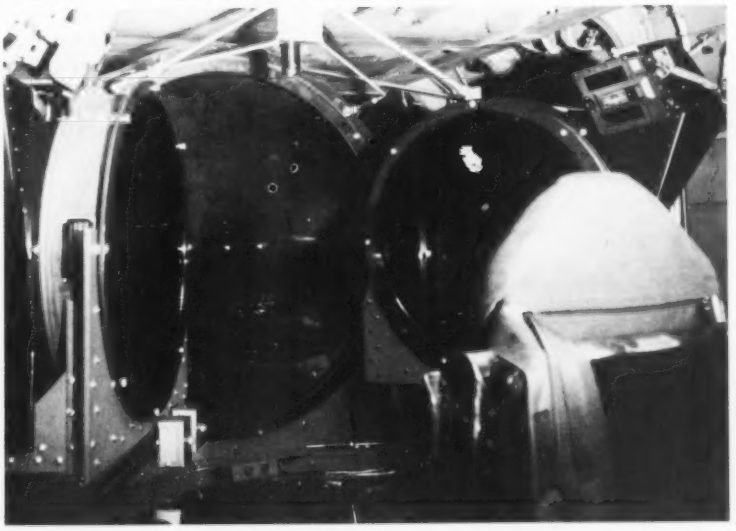
Phase 1 of the test program investigated six aircraft maneuvers:

- the stabilized, precision hover (remaining over a predetermined point at a specific altitude for 2 minutes),
- bob-up and bob-down (consisting of maintaining a precision hover, then increasing altitude to a specified height, hold it for 2 minutes and then returning to the original altitude),
- sideward flight,
- unattended area landings,
- terrain avoidance (TA) and
- terrain following (TF).

These six maneuvers encompass those felt to be the most difficult for pilots to accomplish under night and/or adverse weather NOE conditions using a two-dimensional display as their sole outside reference.

Figure 1

Figure 2 Third pilot's compartment with "pancake windows" for outside view



The TA and TF courses are located in the Martinsburg, WV, area. The TA course (figure 3) is along the Cacapon River which is about 50 feet wide and winds through the mountains. It requires about 5 minutes to fly this demanding course at airspeeds that vary from 30 to 90 knots.

The TF course consists of a nearly straight line course that bisects the numerous razorback ridgelines in the area and has an altitude differential of more than 2,000 feet from the highest to the lowest points along the course. Both courses were selected because of their favorable comparison to the Fulda Gap area of Germany.

The complete results of Phase 1 are published in ECOM's LLNO Phase 1 report, but basically it was

South end Figure 3 North end

determined that Phase 2 would use a variable FOV panel mounted display. It also was found that, while the HMD offered possibilities, there were problems with pilot disorientation that would have to be resolved before continuing any further with this type of display.

Phase 1 data reduction revealed that the pilots were not able to precisely hover the aircraft within the limits prescribed for the medevac and heavy lift helicopters of the future. The pilots' main problem was that while attempting to hold a precise hover they would inevitably begin drifting to the right rear. It was then decided that Phase 2 would look into the effect of superimposing aircraft position information symbology onto a panel mounted display (figure 4).

For Phase 2 the three video monitors were removed and replaced by a single 8 inch monitor. A 14 inch monitor also was tried but did not noticeably increase pilot performance. Flight instruments (absent from the Phase 1 configuration) were arranged around this monitor. These instruments include airspeed indicator, altimeter, radar altimeter, torque gauge, vertical speed indicator and attitude indicator.

This phase was just beginning to start its data collection flights when the aircraft was involved in an accident while on a normal postmaintenance test flight at Patuxent Naval Air Station, MD. A second CH-53A was obtained and the Naval Air Development Center (NADC) at Warminster, PA, set about building and installing the equipment for

Figure 4 Panel mounted display superimposes aircraft's current position

the new RAVE aircraft. This aircraft is now flying and the inflight data collection for Phase 2 has been coming in.

Phase 2 is looking further into the required FOV, resolution, use of minification, and superimposing aircraft position information symbology to help pilots accomplish their demanding task.

Phase 3 was slated to start during the first quarter of FY 1975 and to include data collection runs on the TA and TF courses during the day and night under various night lighting conditions (full moon, half moon, no moon, etc.) and different seasonal conditions (fall, winter, spring, summer) using the newly installed Hughes 525 Discoid Forward Looking Infra Red (FLIR). A laser wire/obstacle detection system also has been installed and tested.

Another intricate part of this test program is the use of ECOM's Avionics Laboratory's tactical avionics system simulator (TASS). This is a four-axis (pitch, roll, yaw and altitude) aircraft simulator (figure 5) which has provisions for the installation of either the 8 inch panel mounted display or the HMD with head tracker. Either of these displays is then connected to a 6 degree of freedom three-dimensional terrain belt. The TASS is used to train the pilots and also to select the most promising equipment configurations for installation and subsequent flight testing in the RAVE. TASS also is equipped with an on-line data reduction system which allows the tested equipment to be assessed with minimal delay.

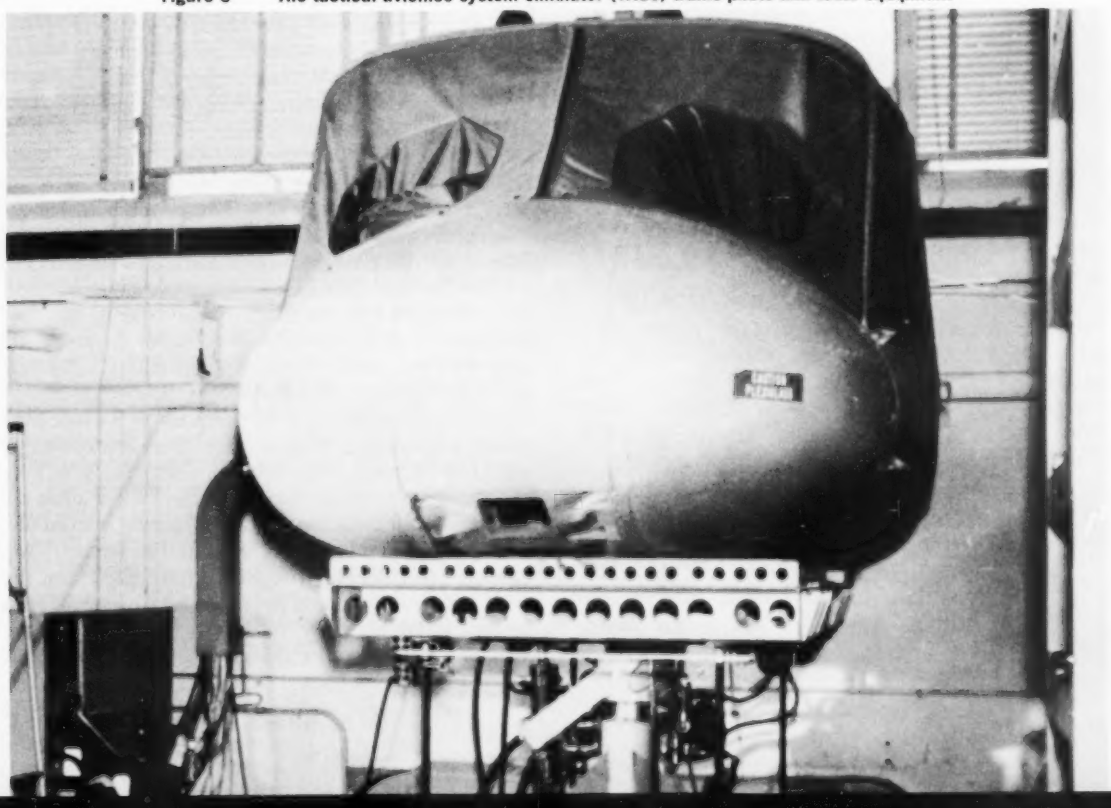
The three pilots currently assigned to Project RAVE are Chief Warrant Officers Randy Dyer, Don Choura and Chuck Tidey. Two of the pilots were previously assigned to the Combat Developments Experimentation Command's "Owl Team" at Fort Ord, CA, and the other has previous night NOE experience with infrared and radar systems (see "NOE At Night" and "Getting Started," March 1974 DIGEST). Although all the pilots now have extensive night NOE flying experience, they have served in operational units in the continental United States and overseas.

While we feel we are covering all possible areas in our search for the most desirable systems, we also recognize the fact that we may have overlooked something. If you feel we may have—or have a suggestion—please feel free to correspond with us at:

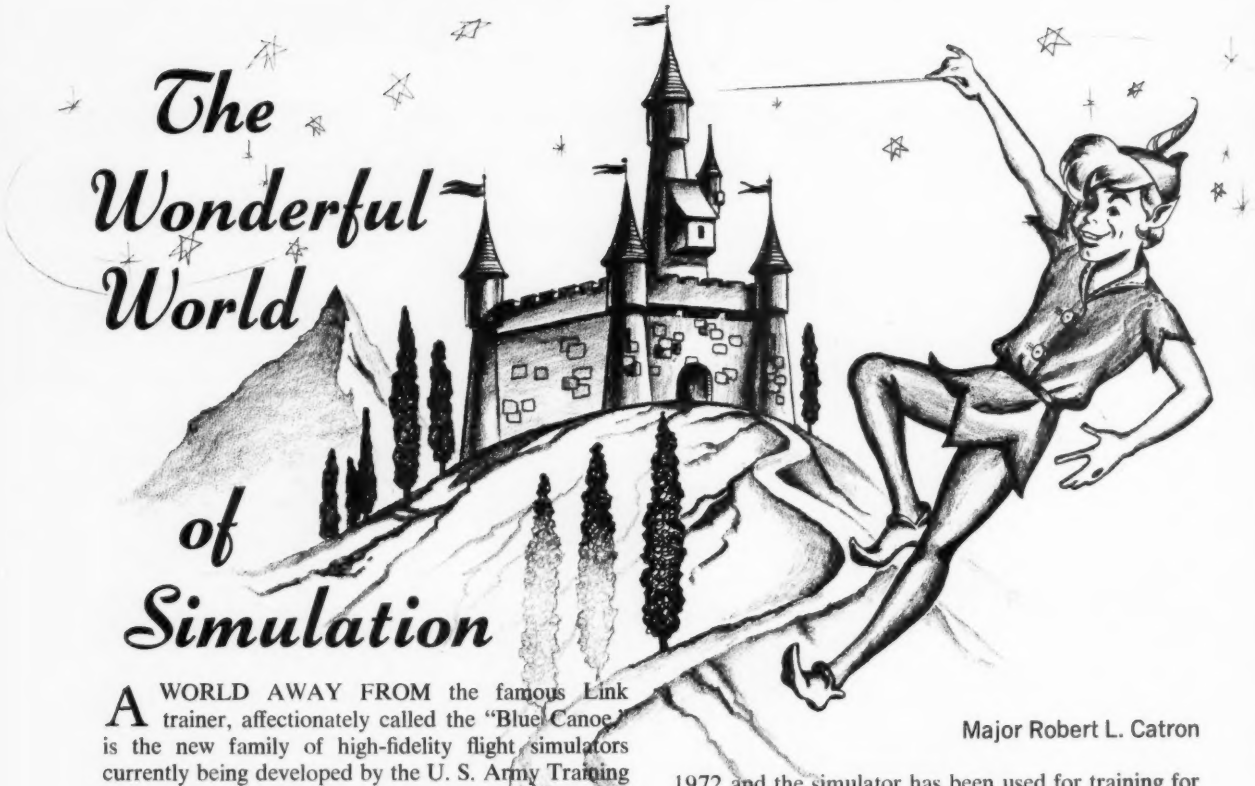
HQ, U. S. Army Electronics Command
ATTN: AMSEL-VL-F/CW2
Chuck Tidey
Fort Monmouth, NJ 07703

Mention should be made here that, at the present time, this test program is concerned with what a pilot will need or will help him to fly an aircraft in the night NOE regime. Other test programs currently are looking into problem areas such as navigation, communications, etc.

Figure 5 The tactical avionics system simulator (TASS) trains pilots and tests equipment



The Wonderful World of Simulation



Major Robert L. Catron

A WORLD AWAY FROM the famous Link trainer, affectionately called the "Blue Canoe," is the new family of high-fidelity flight simulators currently being developed by the U. S. Army Training Device Agency. The buzz word is "visual" and the advanced systems will have a full visual capability.

Before the new systems are presented, let's look at where we are in the world of flight simulation. The pioneering program that started this new concept is called the SFTS. Officially, it stands for synthetic flight training system. Unofficially, it means super fine training system. SFTS is applicable to all helicopters equipped for IFR flight in the Army fleet. The system not only provides training applicable to helicopters in the inventory but added subsystems will also provide for future helicopters such as the AAH (advanced attack helicopter) and UTTAS (utility tactical transport aircraft system).

The now renowned Device 2B24 (UH-1H), a subsystem of SFTS, has had a major impact upon Army aviator training in recent years. It was the first of the SFTS family of simulators to be developed and was delivered to the U. S. Army Aviation Center, Fort Rucker, for development testing in 1971. These evaluations were successfully completed in 1972 and the simulator has been used for training for 12 to 15 hours per day ever since. During fiscal year 1975 there will be six such simulators employed for undergraduate training and combat readiness flying at Fort Rucker and soon after the 2B24 UH-1H flight simulator will be available for Army aviators worldwide (see "View From The Training Base," November 1974 DIGEST for photographs and additional data about these simulators).

MAJ Catron is assigned to the Army Training Device Agency at the Naval Training Equipment Center, Orlando, FL, as project director for SFTS programs. He is an Armor officer and a Senior Army aviator

Now to the new world of full color, real life, high-fidelity synthetic flight training. In June 1973, in its second giant stride into the future, the Army contracted for Device 2B31. This sophisticated flight trainer will be a single-cockpit installation simulating a CH-47 helicopter. Considerably more advanced than the 2B24 UH-1H, the 2B31 trainer will be the first helicopter training device with a visual system. This Singer Hi-Resolution Visual System (SHIRVIS) employs a closed-circuit television with a three-dimensional terrain model. The 56 foot long by 24 foot high model will depict a portion of the Fort Rucker training area. A roving television camera, which is synchronized with cockpit maneuvers, will cover some 94 square miles of Alabama countryside. For example, when the pilot begins his descent for landing, the camera will glide closer to the terrain model and the pilot will have a "real world" visual display of a landing scene. Similarly, the pilot will see appropriate visual displays of other maneuvers that he performs.

The probe, which picks up the visual scene for the television camera, will be an advanced model providing improved depth of focus at any altitude. The terrain model will be lighted to represent varying day and night conditions as desired. Further realism can be achieved by electronically introducing visual effects such as clouds, haze and fog.

The 2B31 CH-47 will "fly" on a 6 degree freedom-of-motion system. This means that it will provide lateral, longitudinal, yaw, pitch, roll and vertical movements. These directional forces will furnish aviators with the acceleration cues experienced in normal and emergency flight maneuvers.

The 2B31 simulator will enhance present transition training in both instrument and contact environments. Training will be furnished in ground taxi, takeoff, hover, forward flight, autorotations and landing. The system will also duplicate missed approaches and go-arounds, confined area landing, and pinnacle and slingload operations. The entire training program will be monitored by an instructor located in the cockpit.

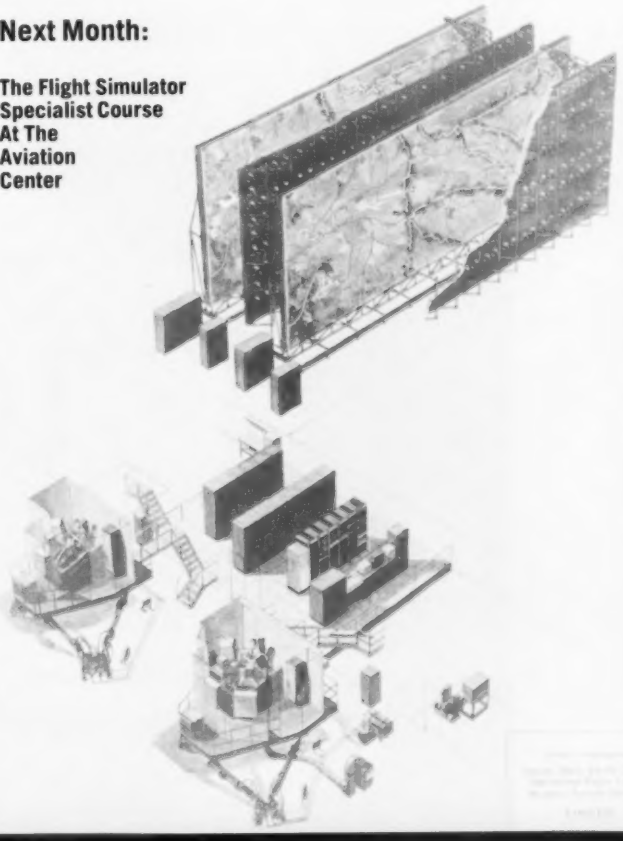
The imagination will be stretched beyond belief when the third SFTS, the 2B33 AH-1Q HueyCobra, is delivered to Fort Rucker in 1976. The 2B33 training system will provide complex crew training for both the pilot and gunner. The two trainer cockpits will duplicate the crew stations in the aircraft. They will operate in the integrated mode (single mission) or in the independent mode (two separate missions). Each trainee station will be mounted on a 6 degree freedom-of-motion system, much the same as the 2B31, CH-47 trainer. The 2B33, like the 2B31, will use the PDP 11/45 General Purpose Digital Computer, which is one of the world's leading computer systems. Its advanced architecture, exceptional performance, almost unlimited expansion capability, and excellent software and support make it the perfect choice for the Army's new generation of flight simulators. Instructor stations will be provided aft of the pilot position and aft of the gunner position. These instructor stations are the most advanced ever designed for a flight simulator. In addition to a cathode-ray-tube (CRT) for graphic display, the instructor's console contains a keyboard for inserting malfunctions, etc., and other controls and indicators arranged by function to provide the instructor with full visibility and control of the student training.

The pilot station will be provided with forward and left side window SHIRVIS displays, as well as a telescopic sight unit (TSU) displaying symbolic imagery. Weapon effects video, including the display of the tracers and projectile impacts, will be generated and mixed with the camera model video. The 2B33 AH-1Q simulator weapons system will include the M28 turret system (7.62 mm machinegun and the 40 mm grenade launcher), 2.75 inch rocket launchers, M18 wing-mounted machinegun, and the TOW (Tube launched, Optically tracked, Wire guided) missile. In addition, the M35 20 mm cannon, as found on the AH-1G will also be simulated. The 2B33 is a fully human-engineered training system tailored specifically to the task of training Army aviators in AH-1Q procedures, aircraft control, instrument procedures, engine control, emergency procedures, weapons delivery, nap-of-the-earth (NOE) flight and radio navigation problems. The 2B33 when completed, will be the first totally integrated sophisticated helicopter weapons system trainer in the free world.

This is today's "wonderful world of simulation." The transfer of training and motivation provided by visual trainers will enhance flight training beyond our dreams. The far-reaching side benefits of aircraft accident prevention, fuel saving and reduced flight hours will allow the Army to spend much needed money on improving operational aircraft. Simulators also will permit greater emphasis on tactics and night testing, thus increasing our combat effectiveness. The challenge is ours!

Next Month:

The Flight Simulator Specialist Course At The Aviation Center



The 2B33 AH-1Q Cobra simulator to be delivered in 1976 will provide complex crew training for pilots and gunners

FLIGHT TESTING
The Unglamorous Side

F. J. McCrory Jr.

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THE TERM "flight testing" has always been associated with the image of a daring, death-defying test pilot who risks life and limb taking up the latest high-performance experimental bird for the first time . . . just to see if the wings—(pardon me)—*rotor blades* stay on. This is a very romantic view of what is a very basic part of the development of any Army aircraft.

Often the words "Aviation Test Board" conjure up images of a group of select Army aviators involved in flying only the very latest vertical take-off landing (VTOL) designs. While it is true that current planning is directed toward evaluation of such advanced rotary wing aircraft as the utility tactical transport aircraft system (UTTAS), advanced attack helicopter (AAH) and heavy lift helicopter (HLH), there is a somewhat less glamorous but significant side to the mission of the U.S. Army Aviation Test Board which is located at Fort Rucker. This involves the testing of helicopters and related systems that cur-

Test Engine Parts Being Inspected by a Board Engineer

rently compose the backbone of the Army aviation fleet . . . UH-1H Huey, AH-1G HueyCobra, CH-47C Chinook, OH-58 Kiowa and OH-6 Cayuse aircraft.

It might be asked, Why is the Army still involved in testing aircraft which have been in use for a number of years? This testing is directed toward determining whether modified components and systems constitute an improvement over the standard versions or whether proposed modifications improve the overall effectiveness of the aircraft. Some examples of this product improvement testing are:

- Ceramic main and tail rotor control rod bearings.
- Improved material for tail rotor grip bearings.
- Fire resistant hydraulic fluid.
- Infrared suppression devices.
- Modified engine mounts.
- Windshields of improved material.
- Elastomeric main rotor bearings.

Another area toward which product improvement testing is directed is determining whether existing component time replacement or inspection periods can be extended. Extension of the authorized hours for both total operation and operation between field inspections can have a significant impact on maintainability and availability and thus the overall effectiveness of the aircraft in performing the Army aviation mission. An area where this type of testing has been successfully exploited is in the product improvement programs of the T53-L-13 and T55-L-11 engines. The T53-L-13 series engine is a turboshaft engine which powers UH-1H/M and AH-1G aircraft. It incorporates a two-stage free type power turbine, a two-stage gas producer turbine which drives a combination axial-centrifugal compressor, an annular atomizing combustor and a reduction gear housed within the air inlet housing.

When the T53-L-13 engine was introduced into the Army test program, the time-between-overhaul (TBO) was 300 hours and the time-between-inspection (TBI) (hot-end) was 150 hours. During the last 8 years of testing and development, which have exceeded 28,000 flight test hours, axial compressor and gas producer nozzle problems have been encountered and solved. Those solutions resulted in evolution of the original T53-L-13 engine to the T53-L-13B configuration, which is currently the backbone of the UH-1H/AH-1G fleet. As a result of testing, the TBO of the T53-L-13B engine has been extended to the current level of 1,800 hours and the TBI to 900 hours. Recent testing completed at the Aviation Test Board demonstrated a 2,400 hour TBO and 1,200 hour TBI. As a result, the TBO and TBI of T53-L-13B engines at the Aviation Center have been advanced to these levels. Further significant advances in the inspection interval of the current T53-L-13B configuration are envisioned upon continuation of testing. The T53-L-13B engine is thus rapidly becoming a benchmark of success for future helicopter turbine engine development.

The T55-L-11 series engine, which powers the CH-47C helicopter, originally had a 300 hour TBO and a 150 hour TBI. Currently the published TBO is 900 hours for the latest version of this engine, the T55-L-11A, with no intermediate hot-end inspection interval. The T55-L-11A is a direct drive shaft turbine engine which incorporates an annular atomizing combustor, a two-stage free type power turbine and a two-stage gas producer turbine that drives a combination axial-centrifugal compressor.

In November 1969 the service test was completed on the latest model Chinook helicopter, the CH-47C, with T55-L-11 engines. In addition to the service test, a logistical reliability test which included a TBO program was conducted. As of 31 December 1970 all dynamic components except the T55-L-11 engine and the engine transmission had attained a field TBO of 1,200 hours or were "on condition." The engine transmission did not reach the 1,200 hour level due to various problems which have been eliminated in the latest configuration transmissions. A satisfactory TBO could not be established for the engine because of the following problem areas:

- First stage compressor blade failures.
- Inlet housing cracks.
- Air diffuser cracks.
- Excessive oil consumption.
- Fuel control spline wear.
- Fourth stage power turbine blade failures.
- Fireshield mounting bolts shearing.
- Combustor liner mounting bracket failures.
- Fuel control inaccuracies.
- Torque indication problems.
- Main nozzle cracks.

On 16 September 1970 the heavy lift systems project manager grounded all CH-47C helicopters equipped with the T55-L-11 engines due to power turbine blade failures experienced both at the Aviation

UH-1H/M TEST PROFILES
Profile #1, 5.0 hours (hrs)

OZR or OZR to 80J

1.5 hrs, 90 knots, any altitude (alt) up to 3,000 feet MSL

1. 10 power changes
   a. Decrease to 15 psi torque and stabilize for 15 seconds
   b. Increase power to 40 to 50 psi (maximum torque without N_2 decay) and hold for 30 seconds
   c. Return to normal cruise
2. 10 level flight "S" turns, 45 degree bank

Refueling Time–15 minutes

OZR or 80J	OZR or 80J
1.0 hrs, any alt up to 1,000 ft MSL	1.0hrs, any alt up to 1,000 ft MSL

DURING EACH HOUR
9 takeoffs and landings at 80J or
6 takeoffs and landings at OZR

a. Use a minimum of 40 psi torque for takeoff provided other engine limitations are not exceeded
b. Terminate approaches to a hover and maintain for 30 seconds
c. Land and reduce collective to minimum, let EGT stabilize

Refueling Time–15 minutes

CH-47C TEST PROFILES
Profile #1; Internal Cargo, 30% of Time

A. 40,000 lbs takeoff (T/O) gross weight (GW), 245 RPM

	Time (min)	%Torque	Rate of Climb	Rate of Descent
Hover	8	60%[1]		
Climb	8	66%	500ft/min	
Cruise[2]	16	57%		
Descent	8	56%		500ft/min

B. 40,000 lbs T/O GW, 235 RPM

	Time (min)	%Torque	Rate of Climb	Rate of Descent
Hover	8	56%		
Climb	8	72%	500ft/min	
Cruise	16	58%		
Descent	8	54%		500ft/min

1 % of torque for hover is average: use % required up to 78%

2 4,000 ft density altitude is desired, if unable use climb % of torque for time required, prior to going to cruise % of torque

Flight Profiles Typical of Those Used in Engine Test Programs

Test Board and in the field. The engine manufacturer developed modifications to correct the majority of the problems. Consequently, a product improvement test of the T55-L-11A engine was begun in February 1971 to provide data concerning the substantiation of the design changes to the T55-L-11 engine.

Three CH-47C helicopters were assigned to the Aviation Test Board for this purpose. They were scheduled at an accelerated flying hour rate of 150 hours per month, per helicopter. Flight profiles and scenarios used were the same as those used on the previous test and were developed based on data obtained from operational units in the Republic of Vietnam. The helicopters were operated continuously at high-load levels through various combinations of gross weight, airspeed and density altitude. Ten T55-L-11A engines initially were assigned to the test program and seven still remain. Through 28 January 1975, 15,634.8 engine hours have been accumulated.

Corrections of the above faults include replacement of first stage compression blades with titanium blades. Inlet guide vanes have been deleted because of the compressor blade change and at press time 28 hours of successful operation have been logged.

OZR: Cairns Army Airfield
80J: Apalachicola
MSL: mean sea level
psi: pounds per square inch
N_2: engine revolutions per minute (RPM)
EGT: exhaust gas temperature

OZR or 80J to OZR

1.5 hrs, 90 knots, any alt up to 3,000 feet MSL

1. 10 power changes
   a. Decrease to 15 psi torque
   b. Increase power to 40 to 50 psi (maximum torque without N_2 decay) and hold for 30 seconds
   c. Return to normal cruise
2. 10 level flight "S" turns, 45 degree bank

Refueling Time—15 minutes

C. 38,000 lbs T/O GW, 235 RPM

	Time (min)	%Torque	Rate of Climb	Rate of Descent
Hover	8	54%		
Climb	8	68%	500ft/min	
Cruise	16	59%		
Descent	8	50%		500ft/min

The Aviation Test Board currently is testing T55-L-11A engines to 2,100 hours in support of a projected TBO goal of 1,800 hours for the fleet. Hot-end inspections at the Aviation Test Board are scheduled for 600, 1,200 and 1,800 hours. The considerable progress achieved during the T53-L-13 and T-55-L-11 engine programs is not accidental but is the result of a dynamic program of development and testing pursued by the Powerplant Branch of the U. S. Army Aviation Systems Command (AVSCOM), St. Louis, MO, in conjunction with the Aviation Test Board.

Test programs at the Aviation Test Board have encompassed flight testing the engines to the projected TBOs and TBIs. Test-bed aircraft have been operated in accordance with specific flight test profiles designed to subject the engine to both steady state and transient conditions representative of those to which the engines are exposed in normal field operations. The accompanying figure shows typical profiles used in the engine test programs.

During the test programs the condition of the engines is monitored by spectrometric oil analysis, engine performance data analysis and the engine health indication test (HIT) system. At the projected TBI intervals the engine hot-ends are completely disassembled for inspection and all inspections are monitored by Aviation Test Board project engineers. The results of these inspections as well as resulting recommendations are reported to the U. S. Army Test and Evaluation Command (TECOM), Aberdeen Proving Ground, MD, and AVSCOM on a continuing basis during the test.

The TBO and TBI of these engines are thus subjected to continuing scrutiny to achieve the maximum in operational effectiveness and economy. This type of aggressive test program can be an excellent model for engine and helicopter dynamic component development programs in the future. If this type of program is conscientiously pursued with current and future generations of Army aircraft, it can result in significant dollar savings and improved operational effectiveness for Army aviation.

In short, the next time someone mentions flight testing, remember that there is a relatively unglamorous side to that business, but nonetheless it is essential to the continuing growth of Army aviation; and, in pursuing that goal, the Aviation Test Board will continue to fly and test those vintage veterans of Vietnam—the Huey, HueyCobra, LOH and Chinook helicopters.

F. J. McCrory Jr.

Mr. McCrory and Mr. Venegas are both aerospace engineers at the Army Aviation Test Board, Aviation Center. Mr. McCrory is project engineer for UH-1, AH-1G and T53-L-13 testing and for the development test of the automatic inspection, diagnostics and prognostics system (AIDAPS). Mr. Venegas is project engineer for the CH-47C transmission and T55-L-11A engine extension programs

M. G. Venegas

Highway accident

Continued from page 5

winds prevented the crew from using the hoist. The pilot was forced to come to a 175-foot hover with the toe of one skid resting precariously on the edge of the tower while the still unconscious painter was loaded aboard the aircraft. The patient was treated onboard and regained consciousness shortly before arriving at Bexar County Hospital in San Antonio.

Although the area of operations of MAST units usually is 100 nautical miles (the fuel radius of the helicopter), they frequently are called upon to fly a patient much farther. This requires a refueling stopover or when time is a critical factor transferring a patient from one helicopter to another.

One such incident happened at Bowie, TX. A man from Indianapolis, IN, suffered serious head injuries in an automobile crash and was taken to Bowie Memorial Hospital for emergency treatment. The attending physician determined the patient should receive extensive neurological care and possible surgery. The nearest facility equipped to provide this service was in Arlington, TX. The nearest MAST unit at Fort Sill, OK, was notified (Fort Sill is about 70 miles from Bowie and 130 miles from Arlington) and 45 minutes later a helicopter from the 507th Medical Company landed at Bowie.

With the help of the highway patrol the pilot landed his UH-1 helicopter in a small confined area of a churchyard adjacent to the hospital emergency room. The crewchief and medic placed the patient aboard the air ambulance and departed for Arlington Memorial Hospital.

Prior coordination with the receiving hospital for the disposition of the patient had not been made and the exact location of Arlington Memorial was not known by the crew. Also, aircraft fuel quantity was now becoming a factor.

To refuel, the pilot landed at Carswell Air Force Base since it was in the line of flight. While the aircraft was being refueled, the pilot notified Arlington Memorial Hospital by phone that he would be inbound with a patient in serious condition. He asked that an ambulance meet the helicopter at the landing site closest to the hospital.

Having solved the first two problems, the only obstacle remaining in the way of a successful mission was to find Arlington Memorial Hospital. An inflight radio call resulted in the Dallas-Fort Worth Regional Approach Control vectoring the aircraft to the hospital. A landing was made on a large ballfield adjacent to the hospital and the patient was placed in the care of ground ambulance crews for the short ride to the emergency room.

The 326th Medical Battalion at Fort Campbell, KY, had a similar long trip that required refueling. The mission was to transfer a patient from Clarksville, TN, to the burn center at Birmingham, AL, 190 nautical miles away. The patient had third degree burns on more than 30 percent of his body.

Burn victim

Photo by Ivan Foster

SCRAMBLE!

To solve the fuel problem a fuel stop at Redstone Arsenal, Huntsville, AL, was planned.

The mission went smoothly. While the aircraft was being refueled an ambulance was onhand to take care of the patient. Air traffic personnel at Birmingham directed the aircraft by radar to Fire Station No. 1 where the patient was offloaded.

Often, time is so critical that the patient can't wait while the aircraft is refueled. This happened with a Flatiron helicopter from Fort Rucker. Flatiron Operations received a call from a doctor at Archibald Memorial Hospital, Thomasville, GA, asking if a patient could be transferred from Thomasville to Emory University Hospital, Atlanta, GA. The patient had suffered an enlarged abscess in her neck which was impairing her breathing. She needed special surgery which was available only in Atlanta. The ride via ground ambulance to Atlanta would take too long and time was against the patient's chances for survival.

Since Atlanta is outside Fort Rucker's normal area of operations, a call was placed to the 498th Medical Company (Air Ambulance) at Fort Benning, GA, to see if it could help. The answer, "Yes!"

The doctor was then informed that Flatiron would pick up the patient, take her to Fort Benning for transfer to the 498th aircraft for the remainder of the flight to Atlanta.

The Flatiron aircraft arrived at Thomasville municipal airport a little more than 1 hour after the doctor had called. With the patient and an attending nurse onboard, Flatiron was enroute to Lawson Army Airfield at Fort Benning for rendezvous with the 498th. One hour and 15 minutes after leaving Thomasville, Flatiron arrived at Fort Benning. The 498th aircraft was ready and the patient and nurse were transferred to the waiting helicopter. One hour and 30 minutes later the patient was at Emory University where the lifesaving surgery took place moments after the arrival of the helicopter. In a little more than 4 hours from the time the doctor called, the patient was in surgery, showing again that the MAST program goes all out to aid those in need.

Sometimes a MAST unit must help rescue a patient. At Fort Riley, KS, MAST Operations received a call from the county sheriff's office requesting emergency evacuation of an undiagnosed patient from an automobile accident site. Fifteen minutes later an 82d Medical Detachment helicopter was on the scene.

The patient was trapped inside of the cab of an overturned flatbed truck loaded with bricks. While the aircraft was being shut down, the copilot, medic and crewchief rushed to the overturned vehicle. The driver was pinned inside, upside down, with a partially severed leg, facial lacerations and possible head and back injuries. Through the combined efforts of the medic and crewchief, the bleeding was controlled and the leg was bandaged immediately.

Throughout the next 1½ hours the medic continued to give aid to the patient while the crewchief organized and assisted in the attempt to release the patient from the wreckage. Upon arrival of a local physician, intravenous fluids (IVs) and pain killers were administered. Rescue operations encompassed highway patrol and sheriff's department officers, rescue squad personnel and many civilian volunteers. Through the use of tow trucks, chains, lifts, pneumatic jacks, spreaders and even a frontload bulldozer the driver finally was freed.

Time from the mishap to release of the driver was about 2½ hours. The patient and the doctor were immediately loaded into the helicopter and delivered to Salina, KS, within 20 minutes, with the patient in satisfactory condition.

A similar mission happened in Georgia. The 498th Medical Company personnel at Fort Benning were asked to go to a lonely stretch of highway 6 miles north of Warm Springs, GA. There they found a young man pinned within the torn wreckage of his automobile. A civilian ground ambulance crew on the scene had been trying without success for more than 40 minutes to free the victim when the chopper sat down in a nearby field. But with the help of the helicopter crew, they managed to free the victim and strap him aboard the aircraft. He was whisked to a hospital—all within 20 minutes.

Sometimes MAST units respond to a civilian call only to find a military man is the victim of the accident. This happened in central New Mexico. A man lost control of his car on a steep and winding mountain road causing it to plunge 400 feet down into a ravine.

The 283d Medical Detachment (Helicopter Ambulance) received a call for help from civilian author-

Preparing for "long range" mission

ities. Upon arriving at the scene of the accident it was necessary to shut down the aircraft and all crewmembers helped to move the patient to the air ambulance. The man turned out to be military, stationed at Holloman Air Force Base. He was taken to William Beaumont Army Medical Center for treatment.

As with other MAST units, the 54th Medical Detachment at Fort Lewis, WA, has its share of automobile accidents and interhospital transfers. But it also has a large number of calls from accidents related to mountain climbing and outdoor activities. As an example, a request came in for a MAST pickup of a male who was injured when a large rock rolled over him. A 54th helicopter picked up a ranger who knew the area and directed the Army helicopter to the accident scene. The medics started IVs, splinted the right leg and attempted to stop profuse bleeding of the leg. They also administered oxygen enroute to St. Joseph's Hospital.

At another time three injured mountain climbers in the vicinity of Snoqualmie Pass in Washington needed medical attention. A 54th helicopter proceeded to Snoqualmie Pass forest ranger station to pick up mountain rescue personnel to assist in the rescue. The helicopter picked up the most seriously injured of the three climbers. The patient was suspected of having a skull fracture and spinal injuries and had lacerations of the face. The medics helped to control bleeding by applying bandages and spinal immobilization and performed psychological first aid. The extent of his injuries made it necessary for the helicopter to proceed immediately to Harborview Hospital, Seattle, WA, with the patient. Another 54th helicopter picked up the other two injured mountain climbers only minutes before it would have been too dark to complete the mission.

While the 54th is often called upon to work in the mountains, it also encounters missions involving injuries incurred below sea level. St. Joseph Hospital in Tacoma, WA, requested the 54th to evacuate two males who were victims of the bends. The patients were administered IVs and oxygen enroute to Virginia Mason Hospital, Seattle, where the decompression chamber is located. One patient was conscious and the other semiconscious, slipping away for short periods at a time.

These are only a few of the many lifesaving missions being performed by MAST units. In every case the helicopter's unique capabilities are being used in the best interest of the patient. In no case are they replacing ground ambulances.

REFORGER

Continued from page 6

four attack aircraft efficiently. The most common mix however was two AH-1 HueyCobras to one OH-58 scout.

On Sunday, 13 October, I was in a three to one mix (three AH-1s, one OH-58) attack section which—in support of the 1st Brigade of the 1st Armored Division—destroyed 23 Blue Force tanks. The attack section accounted for an additional 23 tanks the next day plus three Blue Force AH-1s, their scout, several UH-1s and two fast movers (Blue Force tactical aircraft).

Our umpires had heard of terrain flying but (as I had been) they were a bit skeptical. So, upon occasion they asked us to hold our firing position for an extended time. In one particular instance while the Orange Forces were in retrograde Blue armor was advancing rapidly only a couple of klicks (kilometers) behind the Orange. The Blue armor was in an attack formation when we unmasked on their flank and held our firing position for well over 3 minutes. We flashed our landing lights at them for the 3 minutes before being detected. Then they broke their attack formation and sought cover. At this time the retrograding Orange armored assets regrouped and initiated a counterattack.

During only 4½ days of efficient use (weather and fuel restrictions intervened) the Orange Force attack helicopters accounted for some 200 Blue Force tanks, 6 Blue Force attack helicopters, an assortment of utility and scout helicopters, 2 high performance tactical air fighters, trucks and other light vehicles. Losses consisted of only four aircraft, two of which were scouts.

Weather, blowing snow, low hanging clouds, fall thunderstorms, freezing fog and a staging area far from the FEBA (forward edge of the battle area) helped deter Army aviation effectiveness during Reforger '74. I'm reminded of a quote of Major General John L. Klingenhagen, which appeared on the back cover of the May 1971 DIGEST, from an attack helicopter study: ". . . that if the Army had had a platoon of all-weather helicopter gunships . . . in World War II during the Battle of the Bulge, the Germans would have been stopped cold. For ten out of the seventeen days, regular aircraft could not fly because the weather was too low . . . Just think, with only fifteen helicopters all of those lives could have been saved. . . ." In this respect Reforger '74 was similar to the Battle of the Bulge. Due to their lack of adverse weather capabilities the attack aircraft could not penetrate the weather to get to the action.

AH-1s and OH-58s with iced-up canopies (top). Freezing fog during Reforger '74 limited effectiveness of helicopters, too. Lower photo, Orange Forces operations van—the center of mission planning in the midst of muck and fog

Army aviation played a significant role in Reforger '74. However, with an adverse weather capability it could have done much more. A FARRP (forward area refueling and rearming point) was established to help alleviate the distance from the staging area to the battle area.

Many of us in attack helicopters were assured in Reforger '74 that there is a place for us on the high-threat battlefield, and more important perhaps that we do have a bit of longevity left. One significant lesson learned is that we must institute a training program to tell and show the ground commander what Army aviation can do. Too many still think of Army aviation in the Vietnam environment and can't, or don't visualize Army aviation in the nap of the earth.

Mr. Lopez is a former managing editor of the U. S. ARMY AVIATION DIGEST

TREATED UNTREATED

REPCON

How To Keep Rain From Obstructing Your View

Major Frank L. Alverson Jr.

Attack Helicopter Project Officer
Deputy for Developments
U. S. Army Aviation Center

ONE OF THE PROBLEMS of flying an aircraft in a rainstorm is visibility. The rain that sticks to the windshield obscures and distorts normal vision.

Water on windshields reduces the amount of light that can pass through the transparencies. Water also causes a refraction error making the horizon appear to be 10 degrees lower than it actually is. In addition, the ripples, especially on canopies like those found on the AH-1 HueyCobra, cause objects to appear lower. The effect can be as much as 5 degrees or a 100-foot error each 1,200 feet lateral distance.

In response to the problem various tests were conducted by the U. S. Air Force on a substance called UNELKO Rain Repellent and Surface Conditioner (REPCON). It seems to be not only highly effective as a rain repellent but also effective in preventing spotting from flying insects. REPCON's Federal stock number is 6850-139-5297 and it is available through the Defense Supply Agency.

The Deputy for Developments at the U. S. Army Aviation Center, Ft. Rucker, has gathered information regarding the material and has conducted some limited inside demonstrations using the material on glass and plexiglass. The material worked well in these tests. The Directorate of Industrial Operations at the Aviation Center is using the material not only on the canopies of the Cobra but also on the windshields of the UH-1 fleet with very favorable results.

REPCON is a liquid material packaged in 8-ounce plastic bottles. A bottle will cover 300 square feet of window surface. It contains an isopropyl alcohol carrier with a silicone wetting agent. Because of its flammable nature it must be kept away from fire or other ignition sources.

Once it is on the windshield the alcohol evaporates in about 1 minute leaving the wetting agent on the surface. The wetting solution makes the windshield smooth and causes water to bead. It restores clarity and provides added protection against salt spray, sandstorms and other foreign matter.

Directions for applying the solution are very simple. The surface to be treated must be clean and dry. It is not necessary to remove any previous coating because the material will not build up on itself. Previously untreated surfaces should receive two coats.

A small, soft cloth is folded and soaked in the solution. It's important that the cloth be thoroughly soaked but not dripping wet. The cloth is wiped on the area to be treated in a circular motion. Since oil from the fingers will cause an adverse effect on the treated area the cloth cannot be turned. The solution is allowed to dry for about 1 minute. Another soft cloth or tissue is wiped on the area until all excess is removed. Again, the cloth cannot be turned. When properly prepared the surface will have a clear, smudge-free appearance.

If possible, the repellent should be applied when the temperature is at least 60 degrees F. When the temperature is below this the liquid must be allowed to dry longer.

Any repellent spilled on the aircraft should be wiped up. It does not damage other types of surfaces but prolonged contact may leave spots. Hands should be washed after applying the repellent as it can dry the skin unnecessarily.

The coating reduces the effort required to clean the surface. The treated windshield should be cleaned with a sponge, soft cloth, paper towel or chamois soaked in clear water. Glass or plexiglass cleaning compound will affect the repellent adversely or may remove it altogether.

It's rather difficult to say when the material needs to be reapplied. The speed the aircraft flies, frequent windshield wiper use, heavy rains, removal of frost and high temperature jet blasts are some of the factors which reduce its life. Normally, REPCON will last about 50 flight hours.

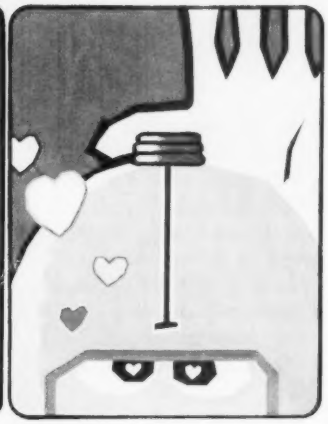
It's easy, however, to make a simple test to see if a new coat is needed. Sprinkle plain water on the coated surface. If the repellent is still good the drops will not spread but remain high. If a new application is needed the water will flatten out over the windshield.

One problem did arise, however. During night operations water droplets remain stationary on the windshield during ground taxi. This causes a distracting glare when external lights are directed on the windshield. The same result may occur if cockpit internal lighting is directed on the transparency. This glare is not from the repellent but from the stationary droplets. Additional rain removal systems may be needed at taxi speeds.

REPCON is inexpensive, costing less than 10 cents per application and can be applied by hand in 3 minutes to a clean, dry windshield. It may be the answer to the visibility problem in rain.

The twins appearing on these pages illustrate the effectiveness of REPCON as a rain repellent

VIEWS FROM READERS



Sir:

The U. S. ARMY AVIATION DIGEST tactics outlook series was and is a very timely group of articles covering training attack helicopter units for their missions. A valuable contribution to the training program would be the consolidation of the series and distribution to nonrated ground commanders to help them know of our capabilities and contributions to the combined arms team.

CW3 Michael S. Lopez
334th Aviation Company
(ATK HEL)
APO New York 09165

• **This is being done. The DIGEST will announce when they are available.**

Sir:

Please publish the following information in the DIGEST:

The 10th Annual Southeastern Airport Management Seminar, sponsored by the Southeastern Airport Managers' Association and Auburn University, will be held 5-6 March 1975 at Auburn University.

Harold R. Decker
Director of Instruction
Auburn University
Auburn, AL 36830

From MILPERCEN

"Pinpoint" assignment procedures to United States Army, Europe (USAREUR) are now in effect for senior NCOs in pay grades E6 through E9. The purpose of these procedures is to streamline the assignment system and improve the morale of senior enlisted personnel assigned to USAREUR.

The notice from USAREUR to the soldier as to the specific assignment in USAREUR should be in the soldier's hands within 7 to 14 days after receipt of the initial oversea notification. The new assignment plan will help to satisfy USAREUR requirements and at the same time permit MILPERCEN to give better service to the Europe-bound soldier.

In addition to being able to give E6s and above their specific USAREUR assignments, the commands will also be able to inform them as to whether they are authorized concurrent travel.

U. S. Army Military Personnel Center

Effective 1 October 1974 MILPERCEN Personnel Assistance Points (PAPs) were established at McGuire Air Force Base, NJ, Charleston Air Force Base, SC, and Travis Air Force Base, CA. The PAPs were established as an extension of MILPERCEN in order to provide authoritative and expeditious response to the personnel needs of the military transient 24 hours a day. The PAPs were further designed to resolve minor impediments encountered during travel.

Personnel encountering difficulties while enroute to oversea assignments may seek assistance from the appropriate PAP. AUTOVON and commercial numbers are as follows:

McGuire Air Force Base	
AUTOVON	440-2053
Commercial	609-724-2100, ext 2053
Travis Air Force Base	
AUTOVON	837-2893
Commercial	707-438-3844
Charleston Air Force Base	
AUTOVON	583-3393
Commercial	803-747-4111, ext 3393/3394

U. S. Army Military Personnel Center

STANDARDIZATION CORNER

Q. AR 95-1, paragraph 4-15(b), provides the pilot with three options if weather conditions encountered in flight prohibit compliance with visual flight rules (VFR). None of the options include provisions for special VFR. If I elect to continue to my destination (inside a control zone, less than VFR), would I be in violation of AR 95-1 to request a special VFR clearance to enter the control zone since 95-1 does not mention special VFR? Assuming special VFR is permitted and I am flying a helicopter under the same circumstances, do I need a special VFR clearance to enter this control zone?

A. AR 95-1 requires Army aviators to comply with provisions of FAR Part 91 when appropriate.

If weather conditions prevent continuation of VFR flight outside of a control zone, special VFR is not an option to continuing the flight under VFR. Special VFR (FAR 91.107) applies only within a control zone.

If a VFR flight can be continued under provisions of FAR 91.105 and AR 95-1 outside of a control zone, you may request a special VFR clearance to enter the control zone. The aviator must realize that there is no guarantee that a special VFR clearance will be granted because of the volume of IFR traffic. This applies to both airplanes and helicopters.

In some cases special VFR is prohibited for airplanes. Control zones are appropriately designated on navigation charts when the restriction applies.

ARMY AVIATION HALL OF FAME

LTG George P. Seneff (USA, Ret.)

On 6 June 1974 seven pioneers were inducted into the U. S. Army Aviation Hall of Fame. This is the fifth in a series of biographies on these inductees

LIEUTENANT General George P. Seneff (USA, Ret.) was graduated from West Point in 1941 and completed flight training at Fort Rucker, AL, in 1956. Under his leadership as Chief, Air Mobility Division, Office of the Chief for Research and Development, the UH-1 test program was begun and proposals were initiated for a medium cargo helicopter which eventually entered the Army fleet as the CH-47 Chinook. General Seneff organized and then commanded the 11th Aviation Group, 11th Air Assault Division (Test) until the successful completion of Army airmobility tests in 1965. Thus, he was in the forefront of the validation of Howze Board (Army Mobility Tactical Requirements Board) recommendations as well as responsible for the development and refinement of tactics, techniques and procedures related thereto. He then served as Director of Army Aviation during a time of rapid and revolutionary expansion and change. This period witnessed the deployment of the first airmobile division to the Republic of Vietnam and its commitment to combat. He later organized and then commanded the 1st Aviation Brigade in Vietnam. While commanding the Brigade, he personally developed the tactical employment SOPs which formalized the relationships, tactics and techniques of Army aviation employment between aviation and its supported ground combat forces. These SOPs are the basis for current employment doctrine and continue to give positive direction to combat operations. The 1st Aviation Brigade, which had more than 4,000 assigned combat aircraft and was responsible for operations throughout the length and breadth of Vietnam, was the largest assemblance of Army aviation in history. General Seneff later commanded Project MASSTER (Modern Army Selected Systems Test, Evaluation and Review) and directed tests of the Air Cavalry Combat Brigade concept which accented renewed interest in nap-of-the-earth (NOE) flying tactics. He retired in 1974.

just judgment

CW2 David M. Battle

THE DAY DAWNED miserably cold and bleak for CWO Jim Crenshaw and with the dawn came the full realization that this might be his last day on earth.

It had been 48 hours since his UH-1 had smashed into the 8,000-foot level of Mt. Lamar in northern Alaska. Jim knew that the weather station at Whitehorse had received his feeble signal for help, because as the last ounce of power faded from the earphones, he heard a voice that seemed to be 10,000 miles away crackle, "Roger, Army 523, we have a direction fix on you." The station was only a hundred miles to the south, but in the frozen wastelands of this climate, a hundred miles might as well be a million.

He'd been in the area a little over a year. Cold weather flying is risky business. He knew this when he decided to leave early Wednesday, but he was obsessed with the idea of getting back home, as was his copilot, LT Fred Baker. Fred had died a couple of hours after the crash from a severe gash in the throat caused by broken plexiglass. Jim nodded as his thoughts ran back over the past two days. Only a fool would fly in a storm like the one that had caused his inlet screens to ice up, and besides, he had been in such a hurry he had failed to load the cold weather survival kits aboard. All of that was behind him now.

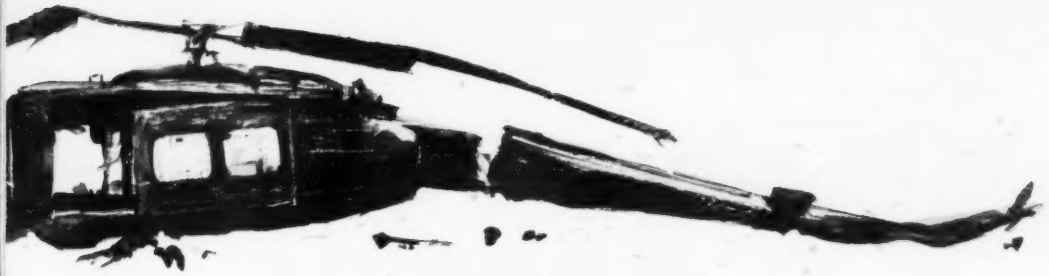
He pulled the soundproofing about him and listened to the winds as they whipped up more snow around the smashed and twisted wreckage of the Huey. He knew it was exceptionally cold because the wind bit into his face as if fire ants had suddenly attacked him. "Damn," he thought, "they should be getting close by now. They've had two full days." Jim had been in country for awhile and he was sure the rescue party was not far off, *just* as sure as he had been about the 1½-hour hop to Ellis Air Base for a fuel stop, and *just* as sure as he had been that his RMI (radio magnetic indicator) really wasn't precessing that much.

The temperature was 20 degrees below zero when he left Whitehorse, but it had to be getting colder because as he moved his toes in his boots he could feel absolutely nothing. "Damn nose sure feels funny," muttered Jim. That was a bad sign and he knew it. A man couldn't last long in this kind of weather. He'd already lost the feeling in his feet, and his arms were beginning to feel like lead weights attached to his shoulders. "Those two cold weather survival kits are probably still sitting by the planning desk at Whitehorse," thought Jim. Over 50 degrees below the freezing mark was something that kept slipping back into his thoughts along with recurring visions of his wife and children when they were notified of his death. It took something like this to show him that he didn't know as much as he thought. Two tours in the Republic of Vietnam, 3,500 hours flight time and a 3-year tour in Europe meant little in his present situation.

Struggling to get out of the wreckage, he had severely slashed his arm on the broken plexiglass, and this made matters worse in a situation where it looked as if things could only get better. Looking at the sky told him differently. The outlook was dark as were the clouds, his situation was desperate and time was running out.

Saving his few matches for the drone of a searchplane was doubly necessary, since he'd gotten through on the radio. The only catch was, at a thousand feet above the timberline, he didn't even have wood or sprigs for a fire. The aircraft had crashed on the mountain plateau just below the crest and as far as he could see, there wasn't anything except sheer rock above. "Bet that altimeter was more than *just* 100 feet off too, but I was sure it checked OK at Whitehorse. Temperature maybe?"

Trying to go down the mountain would be foolish.



The first rule of survival in this country is to stay with the wreckage, *if* you're lucky enough to survive the crash. It doesn't take long to get permanently lost in the white wilderness.

Gathering all burnable material into one spot taxed Jim's waning strength so badly that after he'd struggled with a splintered wooden parts crate for what had to be an hour ("Hell, I was *just* 250 pounds overgross when I left"), he fell exhausted into the little den he had made for himself in the aft section of the aircraft. It shielded him from all the elements except the numbing cold that penetrated everything. Even the exposed seat webbing splintered into pieces as he tugged at them, trying to pile them up with all the rest of the burnable materials so he could strike a match to all of it when he heard the sound of a searchplane. "They have to be on their way. They just have to," he mumbled as he sank into a semiconscious sleep.

His dreams wandered from the seashore where he had spent so much time in the years before, and then to the warm memories of home, family, food, warmth, ahhh . . . warmth.

Jim rolled over and thought he heard the sound of crunching snow. His heart stopped! It was an animal, but no, there weren't any animals in this range of rocks, not above the timberline at any rate. Then he heard a voice, "Hello, is anyone around?" He couldn't move. He couldn't even think. Then, as he was trying to get up from his restless sleep, an arm appeared and pulled back the piece of sheet-metal Jim used as a door. A fur-lined parka appeared. There had to be a face inside it, but that didn't matter. Here was a rescuer. "Jim Crenshaw?" the voice boomed. "Are you Jim Crenshaw?" Jim barely managed to stammer, "Yes." The arm pulled him to his feet and the voice said, "I've come for you. The rescue party took the wrong turn at the base of the canyon, but I've come for you. Don't worry, I was *just* ahead of them."

Jim couldn't focus his eyes as he was succumbing to the cold, but he allowed himself to be helped to his feet. A sudden, comforting warmth enveloped him and he felt another wave of drowsiness sweep over him as he struggled away from the wreckage. "Wait a minute," he said. "Let me get my logbook." As he turned to reach back into his small refuge, he was horrified to be looking down at his own blue, frozen, dead body. His head reeled. Now he knew who his rescuer was! No wonder he had found him when the search party took a wrong turn! His head swam and he felt himself falling into a bottomless pit. Everything went black.

When Jim regained consciousness, he wasn't aware of the intense cold and the throbbing pain in his cut arm. Dreams, that's all. It was *just* a dream. Ha! What tricks this cold can play. As he stumbled from his shelter, he thought he saw a figure moving towards him from below. He staggered to the edge and yelled as loud as his half-frozen lungs would allow, "Hello there, can you see me?" The figure stopped, looked up and asked, "Are you Jim Crenshaw? I've come for you. The rescue party took the wrong turn at the base of the canyon . . ."

Survival gear has been developed to save lives. Procedures have been established to accomplish missions and save lives. You JUST might want to think about it.

CW2 Battle is presently serving at Ft. Rucker, as an instructor pilot for the Advanced Division of the Department of Undergraduate Flight Training. He teaches transition and tactics/nap-of-the-earth flying

VORTEX

VORTEX CAN MOST SIMPLY be described as swirling motion. Wake is described as the track left by a moving body. Turbulence is irregular atmospheric motion.

Every aircraft, while in flight, generates a pair of counterrotating vortices trailing from the wingtips. With a helicopter as the generating aircraft (GA), the vortices trail from below the rotor tips when the aircraft is in forward flight (figures 1 and 2).

For several years a suspected cause factor in many accidents was propwash and, later on, jet wake, until this invisible hazard to aviation was discovered. Propwash and jet wake are still hazards but their existence is more obvious than vortices. Vortex wake turbulence was recognized as early as 1952, but little was done about it until recent years. With the development of larger and heavier aircraft, the hazards of vortices have become a major safety concern to aviation. Vortices were suspected or proven to be a cause factor in the following accidents.

- A helicopter was on a southerly heading at 800 feet. Two F-104s were on an easterly heading at about the same altitude. The first F-104 passed about 1,000 feet in front of the helicopter and the second one passed to the rear. The helicopter nosed up and pieces were seen coming off. It fell in an inverted attitude into a wooded area.
- The pilot of a small fixed wing aircraft taxied to the approach end of the runway, made his engine runup and pretakeoff check and was waiting for takeoff clearance. A C-130 pilot was cleared to land, but made a go-around because his approach was too high. The pilot of the small aircraft was cleared and started his takeoff. The aircraft broke ground just as the C-130 started a crosswind turn. The small aircraft's climb was normal until it reached an altitude of 100 feet and was two-thirds of the way down the 4,500-foot runway. Suddenly it rolled violently to the right, then to the left. It went into a steep dive and crashed.
- A fixed wing aircraft entered traffic following a CH-47. The CH-47 pilot made his approach over the active runway to a panel adjacent to the runway and terminated to a hover over the panel. Just as the fixed wing aircraft was starting its roundout, the left wing went down. The pilot added full power and initiated a go-around. Suddenly the fixed wing aircraft rolled violently to the right. The right wing struck the runway and the aircraft crashed inverted.

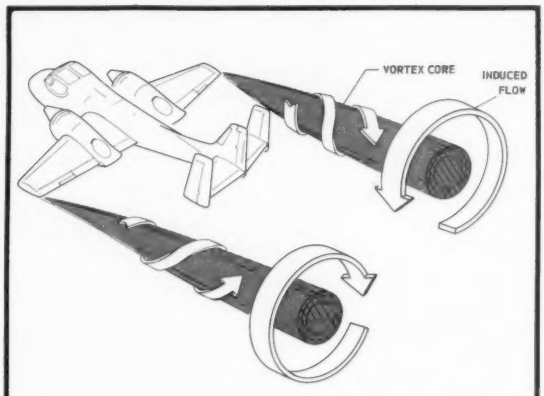


FIGURE 1

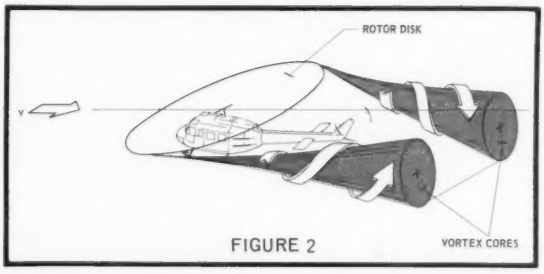


FIGURE 2

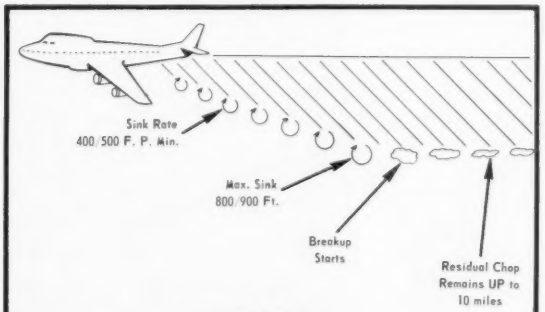


FIGURE 3

Arnold R. Lambert
Publications and Graphics Division
U. S. Army Agency for Aviation Safety

USAAAVS

WAKE TURBULENCE

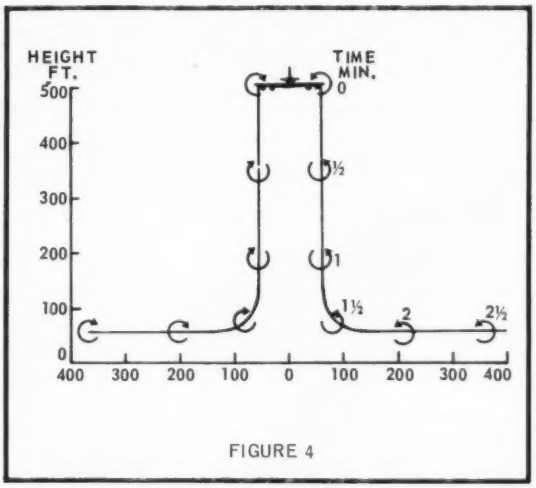


FIGURE 4

■ The tower cleared a twin-engine aircraft to land following a Boeing 707 and issued a caution of possible wake turbulence. The pilot planned and flew his approach above the flight path of the 707 to touch down beyond the touchdown point of the 707. The twin-engine aircraft was approximately 4 minutes behind the 707. As the aircraft descended to approximately 100 feet above ground level (agl), it entered an area of extreme turbulence and rolled violently to the right. The aircraft wings were vertical (90 degrees from level) before the pilot and IP (instructor pilot), acting in unison, could react to level the aircraft. The aircraft rolled back through the level position and slightly to a left-wing-low position and the left dipole antenna and left main landing gear struck the runway. The pilot had applied full power upon entering the turbulence and as the aircraft struck the runway the propellers became effective. The pilots made a go-around and returned to the airfield from which they had taken off. It was determined that the wind caused the wake turbulence to drift down the runway and into the flight path of the landing twin-engine aircraft.

Many tests have been conducted in recent years in an effort to reach a possible solution to this problem. In some of the tests, this invisible menace was made visible by installation of smoke generators on the GA. The following information was learned concerning characteristics and behavior of vortices.

Characteristics. The vortex trailing from each wingtip is generated when lift is developed. The lowest pressure is near the center of the upper surface, which tends to draw the airflow over the top of the wing inward from the wingtip toward the fuselage. The highest pressure is near the center of the lower surface, which makes the airflow under the wing bend outward in an effort to equalize the pressure. The resulting circulation and the downward effect of the airflow over the wing causes the air leaving each trailing edge to form a vortex. The generation begins the moment the nosewheel lifts off the runway and ends when the nosewheel touches down. (For the sake of clarity, please note that although generation ends with touchdown of the nosewheel, the vortices already created could still be in the area.)

Vortices intensity depends on weight and speed of the GA. Weight is the basic factor contributing to vortices intensity. The greatest strength of vortices is generated on takeoff and landing when the GA is heavy and slow and a high angle of attack exists.

Behavior. Vortices behavior is sometimes affected by wind conditions and cannot always be accurately predicted. Here are some of the behavior patterns discovered during tests.

The vortex trailing behind the left wing rotates in a clockwise direction and the one from the right wing rotates counterclockwise. Tests with heavy aircraft have shown that the diameter of the vortex core ranges from 25 to 50 feet, but the field of influence is larger. The vortices remain close together, about three quarters of the wing-span of the GA, until dissipation. When generated by a heavy jet, they begin to descend at a rate of 400 to 500 feet per minute and tend to level off after a descent of 800 to 900 feet (figure 3). Time and distance behind the GA are the major factors for decreasing intensity and eventual breakup of the vortices. Natural atmospheric turbulence can shorten breakup time, but even then a choppy condition can remain in the area for some time.

Vortices generated low enough to reach ground level tend to separate and move laterally over the ground at about 5 knots (figure 4). A crosswind at ground

level, depending on its speed, could cause upwind vortices to remain stationary on the runway. The wind could also increase the drift of downwind vortices to a paralleling runway. A tailwind could move the vortices forward beyond the touchdown point of the GA.

Vortices Encounters. The effect and seriousness of encounters with vortices depend on several things. The greater the distance from the GA, the lesser the effect on the encountering aircraft. The size of the encountering aircraft as compared to the GA is important. The smaller encountering aircraft will receive more violent effects. Low altitude encounters can be more serious because there will be less time to regain control of the aircraft. Direction is also a determining factor as to the seriousness of the encounter. Figure 5 shows three points of encounter and their effect on the penetrating aircraft. The severity, as stated before, would depend on distance from the GA and size in comparison. Crosstrack encounter (aircraft A) would create an updraft, downdraft and updraft effect, in that order. Along-track between

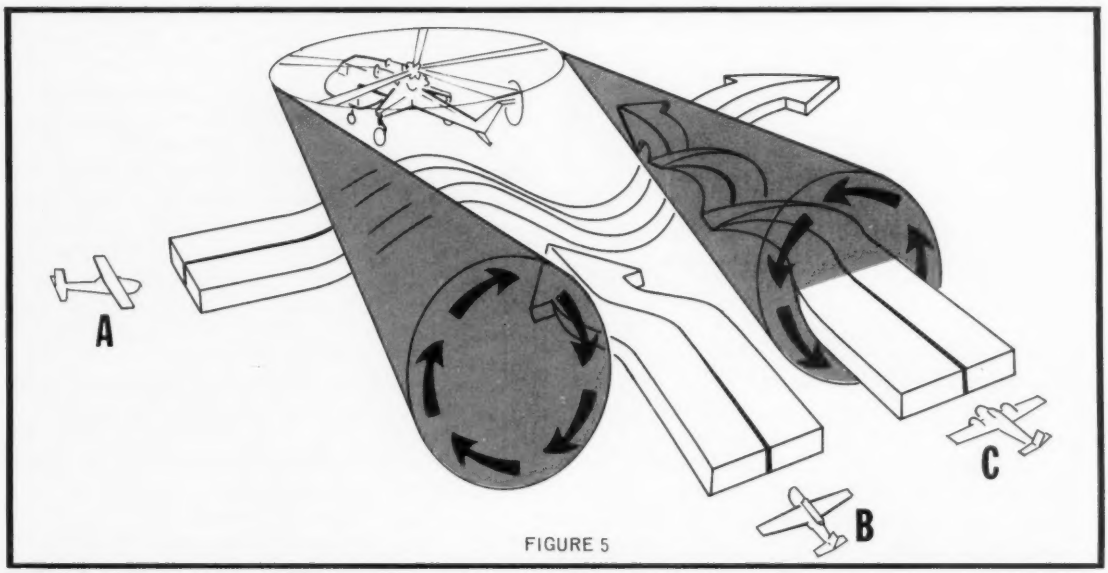


FIGURE 5

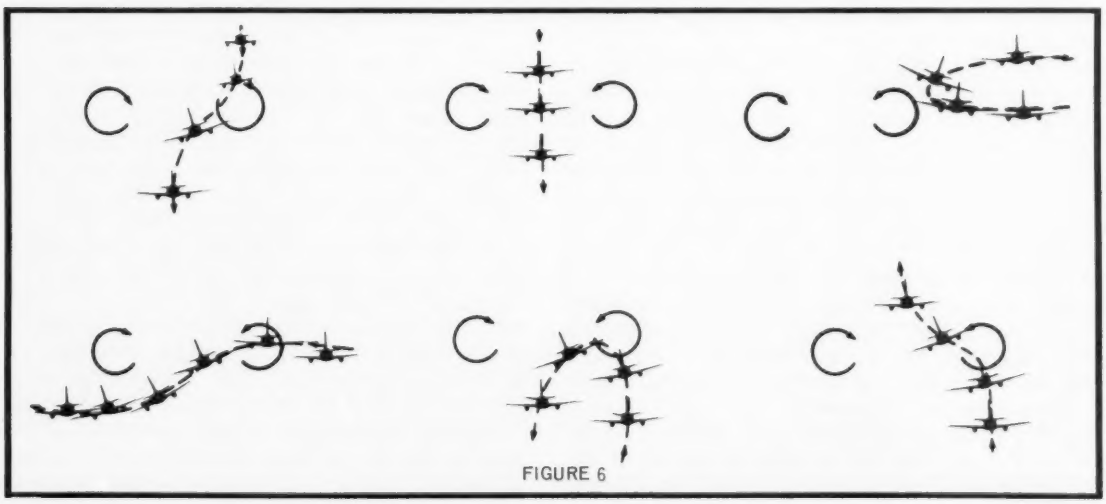


FIGURE 6

vortices (aircraft B) would produce a downdraft effect. This is because the counterrotating vortices create a downdraft between them. Along-track through vortex center (aircraft C) is the most hazardous encounter because it could produce a violent roll beyond the structural limits of the aircraft. Figure 6 shows some additional points or directions of encounter and probable effect on the aircraft.

FIGURE 7

Landing behind a large aircraft–same runway: stay at or above the large aircraft's final approach flight path–note his touchdown point–land beyond it.

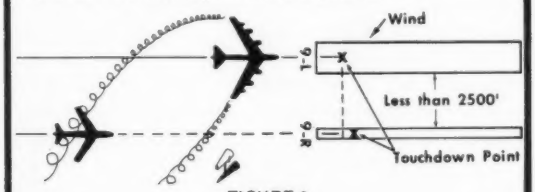


FIGURE 8

Landing behind a large aircraft–when parallel runway is closer than 2,500 feet: Note wind for possible vortex drift to your runway–request upwind runway if practical. Stay at or above the large aircraft's final approach flight path–note his touchdown point–land beyond a point abeam his touchdown point.

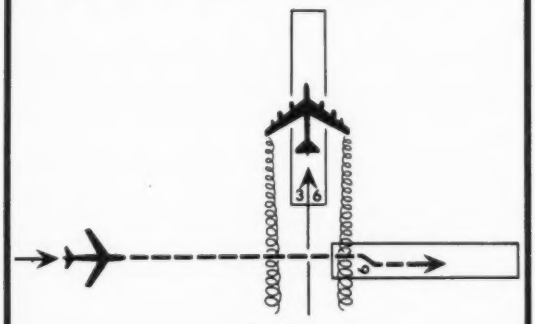


FIGURE 9

Landing behind a large aircraft–crossing runway: Cross above the large aircraft's flight path.

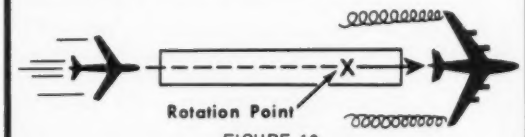


FIGURE 10

Landing behind a departing large aircraft–same runway: Note large aircraft's rotation point–land well prior to rotation point.

Vortices avoidance procedures. The Federal Aviation Administration's (FAA) Air Traffic Service is applying IFR (instrument flight rules) separation standards designed to preclude vortices encounters, but in most VFR (visual flight rules) situations the pilot sets up his own separation from other aircraft. Since he alone controls his potential encounter with vortices, he should be able to visualize their behavior and probable location. The location of vortices at higher altitude is difficult to predict because visual contact with the GA is not always established. When the location and flight path are known, the pilot should fly at or above the altitude of the GA. Avoid the area behind and below the GA. Persistent vortices encounter can often be avoided by a slight lateral change

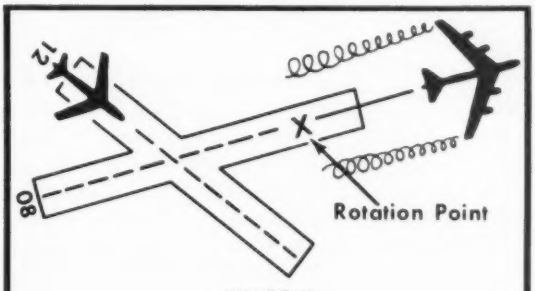


FIGURE 11

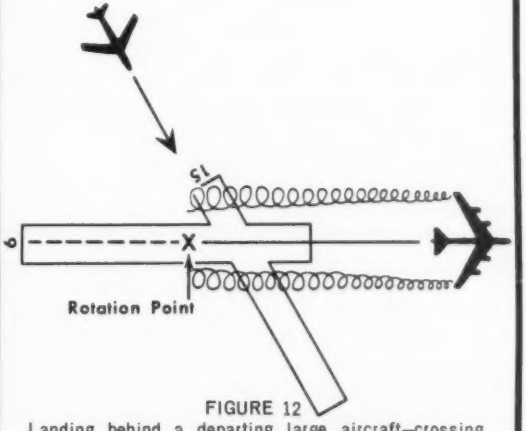


FIGURE 12

Landing behind a departing large aircraft–crossing runway: Note large aircraft's rotation point–if past the intersection–continue the approach–land prior to the intersection (figure 11). If large aircraft rotates prior to the intersection, avoid flight below the large aircraft's flight path. Abandon the approach unless a landing is assured well before reaching the intersection (figure 12).

in flight path. Vortices tend to level off at 800 to 900 feet below the GA. Therefore, when it is not possible to fly above the GA, stay 1,000 feet below it until lateral change in your flight path can be made.

The possibility and probability of vortices encounter increases at air terminals with large aircraft traffic. Under certain conditions the ATC will apply procedures for separating other aircraft from large aircraft. They will also provide VFR aircraft with which they are in communication and which, in the tower's opinion, may encounter vortices from a large aircraft, the position, altitude and direction of flight of the large aircraft. They will follow up with the phrase "Caution—wake turbulence." Thereafter, the VFR pilot is expected to adjust his operations and flight path as necessary to avoid vortices encounter.

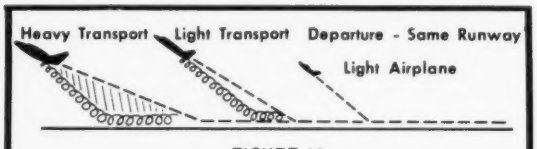


FIGURE 13

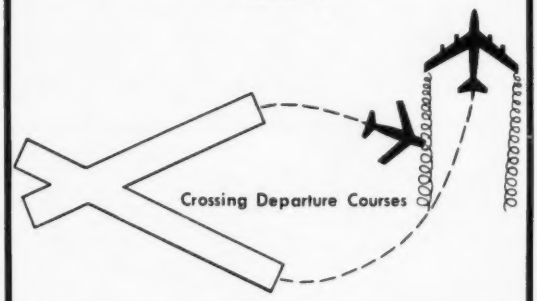


FIGURE 14

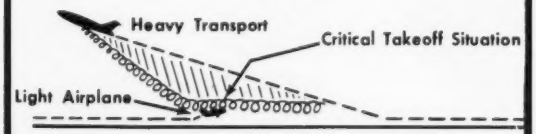


FIGURE 15

Departing behind a large aircraft: Note large aircraft's rotation point—rotate prior to large aircraft's rotation point—continue climb above large aircraft's climb path until turning clear of his wake (figure 13). Avoid subsequent headings which will cross below and behind a large aircraft (figure 14). Be alert for any takeoff situation which could lead to a vortex encounter (figure 15).

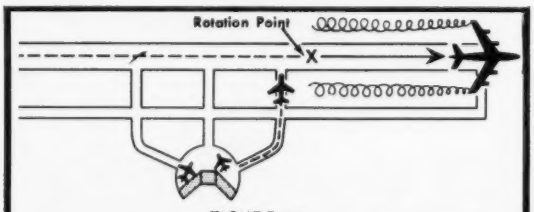


FIGURE 16

Intersection takeoffs—same runway: Be alert to adjacent large aircraft operations particularly upwind of your runway. If intersection takeoff clearance is received, avoid subsequent heading which will cross below a large aircraft's path.

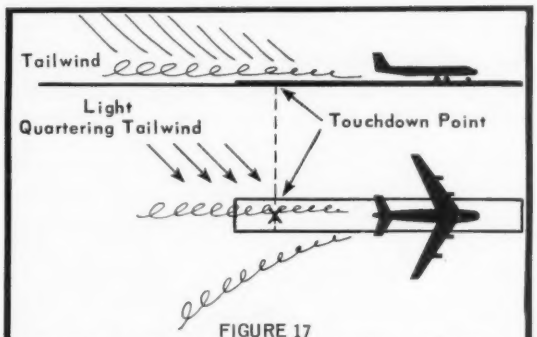


FIGURE 17

The light quartering tailwind requires maximum caution: Pilots should be alert to large aircraft upwind from their approach and takeoff flight paths.

The vortices avoidance procedures for takeoff and landing situations shown in figures 7 through 17 were published in the FAA Advisory Circular 90-23D dated 15 December 1972, and are reprinted by permission.

Additional wake turbulence information can be found in "What is Your Wake Turbulence IQ," May 1973 DIGEST, and "The Illusive CAT," June 1973 DIGEST.

USAAAVS is preparing a decal containing operational tips on how to avoid vortex wake turbulence. The decal will be a constant reminder as well as a ready reference for aircrews. Availability of the decal will be announced in Flightfax.

No pilot, due to his natural instincts for self-preservation, would deliberately fly into a tornadic funnel. Vortices are, in a sense, horizontal tornadoes. Scientists have already proven that vortices can be detected. A test was conducted using a laser system and a heavy aircraft flying low over a high smoke tower. The laser system detected and recorded the wake turbulence before it was sighted in the smoke. Research is continuing and perhaps some day a detection and warning system will be perfected. Until that time, the pilot, with help from the tower, must be aware of possible wake turbulence in his flight path and the necessary precautions he should take to avoid the hazard.

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PILOT-ERROR ACCIDENTS AREN'T ALL PILOT

PART II

THE ARTICLE ENTITLED "Pilot-Error Accidents Aren't All Pilot" which appeared in the January issue of the U. S. ARMY AVIATION DIGEST revealed the magnitude and persistence of human error as an Army aviation problem. It also showed that man's unique abilities make him the strongest element in the aviation system while his psychological and physiological limitations simultaneously make him the weakest. Last, it explained how mistakes imposed on his duty position by other elements in the aviation system place an overload on man's system role which, in turn, lead to unreliable performance and task errors, some of which cause accidents.

It must be emphasized that the human-error accident is a definite indication that at least one element of the Army aviation system is not operating at maximum efficiency. It also must be emphasized that the accident report can be an outstanding source of information about what went wrong, what caused it and what can be done to correct it. Such information can be used to improve the efficiency of operations at unit and higher levels. However, potential benefit of this information "bought" by injuries, fatalities and aircraft damage is tied directly to the quality of the report, that is, how well the accident investigation team identifies, reports and develops recommendations to deal with inadequacies in the Army aviation system. Unfortunately, most reports of human-error accidents leave much to be desired in each of these investigative areas. In this article, which is a follow-on of the article published in January, we will explain what you, as part of the accident investigation team, can do to help cure the problem by precisely identifying, reporting and recommending remedies for human errors.

Identifying human error. From 1958 through 1972 accident boards identified pilot error as a factor in 80 percent of all Army aviation accidents. Unfortunately, reports submitted on many of these accidents indicate the boards, after discovering pilot error as a factor, were satisfied to let it go as such because "everybody knows you can't do anything about pilot error." What these boards frequently fail to realize is that some errors are imposed on the pilot and some are originated by the pilot. The causes of both can be traced back to correctable inadequacies in the aviation system, i.e., selection and training, vehicle/equipment design, maintenance, facilities, environment, supervision and changing psychological and physiological states of the man. In other words, accident boards have been more than willing to identify pilot error as a factor but have stopped short of identifying mistakes of others which caused or allowed the pilot to err.

Reporting human error. Unfortunately, even when accident boards properly identify the pilot and nonpilot human errors involved in accidents, many times they fail to properly report the relevant information. For example, instructions to DA Form 2397-1 direct that for personnel cited as a definite or suspected cause factor, DA Forms 2397-8 (personal data) and -9 (psychophysiological/environ-

mental data) should be completed. However, -8 and -9 forms are almost never completed on nonpilot personnel, e.g., mechanics, maintenance officers, unit commanders, operations officers, safety officers, air traffic controllers, ground unit commanders, higher level commanders, etc. When -9 forms are completed for similar duty positions (e.g., pilot and copilot) in the same accident, accident boards often "score" the accident instead of the person, i.e., the same -9 items are checked for both persons although some apply to only one. Many times boards complete a -9 form and, contrary to -1 instructions, fail to complete the -8 form which is the only source of personal and duty-background information to assist in determining why errors were committed. Even when a -8 form accompanies a -9 form, it frequently is not completed in full. For example, a recent review of -8 information revealed only 41 percent of the items on this form were completed when it was submitted. However, the U. S. Army Agency for Aviation Safety (USAAAVS) must also share the blame for shortcomings in accident report information

TABLE 1
Tasks and Task Errors

SUPERVISORY TASKS

Providing or managing information

1. Providing or managing publications
2. Providing or managing forms and records
3. Providing or managing regulations/SOPs/policies

Providing or managing procedures/applications

4. Performing required inspections
5. Monitoring organizational performance (personnel and equip)
6. Accepting tasks or missions (comparison of task requirement to personnel and equipment capabilities)
7. Assignment of personnel
8. Assignment of equipment
9. Task/mission briefing
10. Task/mission coordination

CREW COORDINATION TASKS

11. *Inspection of:*
    1. Components and systems (vehicle, equip, tools)
    2. Forms and records (vehicle, equip, tools)
    3. Personal and required equipment
12. Performing weather analysis
13. Filing flight plan
14. Revising flight plan
15. Flight departure
16. *Transmission/receipt of communication*
    1. Crew-to-crew
    2. Crew-to-external (LZ control, ATC, Flights, etc.)
       a. Transmitting task assignment
       b. Receiving task assignment
       c. Transmitting status report of task assignment
       d. Receiving status report of task assignment

PSYCHOPHYSIOLOGICAL TASKS

Collecting information

17. Monitoring field of view
18. Monitoring performance of equipment (engines, instruments, machines, etc.)
19. Monitoring performance of others (students, other crew, subordinates, etc.)
20. Identifying/recognizing equipment (switches, controls, machines, tools, etc.)
21. Identifying/recognizing geographic elements (landmarks, stars vs. lights, etc.)
22. Analyzing meteorological conditions (wind, clouds, temperature/density altitude, etc.)
23. Collecting information using required/accepted procedures
24. Estimating clearance (vehicle-to-objects/vehicle)
25. Estimating rate of closure

Using information and procedures

26. Selecting course of action using formal procedures (AR, FM, TM)
27. Selecting course of action using SOP or accepted procedures
28. Selecting course of action for which there is no established procedure

Operating controls, equipment or tools

29. Coordination of actions (tool, equip or control)
30. Timing of actions (tool, equip or control)
31. Direction of actions (tool, equip or control)
32. Selection of proper (tool, equip or control)

Maintaining attention

33. Readiness (not daydreaming)
34. Focusing attention (not being distracted)
35. Dividing attention (proper attention given to required tasks)

Maintaining orientation

36. Maintaining spatial orientation
37. Maintaining geographic orientation

TASK ERRORS

1. Failed to perform required action
2. Performed nonrequired action
3. Performed required action but out of sequence
4. Performed required action but out of tolerance
5. Performed nonrequired/required action in wrong direction

A.	Action Sequence	1. Too soon 2. Too late
B.	Action Magnitude	1. Too much 2. Too little
C.	Action Duration	1. Too long 2. Too short
D.	Action Manner	1. Inadequate 2. Abrupt 3. Inaccurate 4. Incorrect 5. Unauthorized 6. Inadvertent

about human error. For example, USAAAVS is now revising the -8 and -9 forms to eliminate items that are of questionable value and add items which will allow accident boards to clearly and accurately report what happened and why it happened for pilot *and* nonpilot personnel.

Recommending remedies for human errors. The accident report should tell what happened, why it happened and what must be done to reduce the chances of it happening again. Where human error is concerned, most accident reports leave much to be desired in recommending remedies. One of two things usually happens. If "what happened" and "why it happened" information is reported on the -8 and -9 forms, it may not even be mentioned in the findings and recommendations (-2) beyond the fact that human error was a causal factor. Or, if a recommendation is written against human error, it usually states that a certain procedure was not complied with, that it should be complied with in the future and that the facts and circumstances surrounding the accident should be made available to other aviation personnel. What is needed are findings and recommendations that (a) provide a precise statement of the man's task and how it was incorrectly performed, (b) identify each inadequacy in the aviation system that played a role in the accident and explain how it caused or allowed human error, and (c) state who is to do exactly what to correct each system inadequacy.

From the above discussion it should be obvious that, where human error is concerned, the accident board should concentrate on the man and not on the accident. In other words, the accident board's job is not only to describe the accident but also to describe what part of the man's job was performed incorrectly, why it was performed incorrectly and what can be done to reduce the probability that others will commit similar errors. For all Army aviation personnel who may at sometime be a member of an accident board, the following information is offered as a means of increasing the ability to identify, report and recommend remedies for human error.

First, when a man's performance of his job deviates from that required by the operational situation and causes or contributes to a mishap, DA Forms 2397-8 and -9 should be completed on this individual. Performance "required by the operational situation" includes that governed by formal or on-the-job training, by regulation, by standard operating procedures or by other directives in the context of the particular operational situation.

Second, the duty positions of personnel whose job performance should be checked for possible contribution to the mishap are listed in the Guidelines for Completion of DA Form 2397-2. It is suggested this task be directed by the flight surgeon with cooperation of experienced operational personnel. For example, if maintenance error was suspected, the flight surgeon would enlist the aid of a maintenance specialist knowledgeable of the type of vehicle/equipment, mission and operational environment involved in the mishap. The flight surgeon is best qualified to detect and report human error factors from information collected jointly with the expert who best understands the job from an operational standpoint. Table 1* presents a list of tasks and task errors which will help in identifying the man's task and how it was performed incorrectly.

Third, once the flight surgeon and operational expert have identified a task which was performed incorrectly and caused or contributed to the mishap, a precise statement of the man's task and how it was performed incorrectly should be written.

Fourth, inadequacies among basic elements of the aviation system which caused or allowed the human error should be determined. Table 2 provides a checklist that can be used to assist in identifying system inadequacies which played a role in the mishap.

Fifth, for each system inadequacy identified, a statement should be written which explains the causal relationship between the system inadequacy and the resulting human error.

Sixth, one or more remedial measures should be selected for each system inadequacy identified. Table 3 is a checklist which will assist in this task. Each remedial measure should be written to clearly state who is to do exactly what to correct the system inadequacy.

Last, this information should be reflected in the findings and recommendations (-2). Specifically, they should indicate (a) the duty position of the person committing each task error, (b) the checklist item and written description of the task error, (c) the checklist item and written description of each system inadequacy that caused or allowed the task error, and (d) the checklist item and written statement of remedial measures for each system inadequacy.

It should be obvious that when the above steps are properly executed and the personal data (DA Form 2397-8) recorded, the human-error portion of the accident investigation will have been completed, including all of the findings

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**Tables 1, 2 and 3 show experimental checklists that USAAAVS is testing using actual accident report information. Final revisions of these checklists are intended to replace DA Form 2397-9*

TABLE 2
System Inadequacies

Inadequate School Training
1. This duty position/MOS
2. Other duty position/MOS
3. Vehicle, equipment, or tool

Inadequate Informal/OJT Training
4. This duty position/MOS
5. Other duty position/MOS
6. Vehicle, equipment or tool

Inadequate Experience
7. This duty position/MOS
8. This type mission/task
9. This operational area (geographic or work/duty)
10. Type/designation vehicle, equipment or tool (R/W, F/W, torque wrench, etc.)
11. Model/series vehicle, equipment or tool (UH-1A, MD 3 generator, ft.lb. or in.lb. torque wrench, etc.)

Inadequate Psychophysiological State
12. Rest (sleep, breaks, working hours)
13. Nutrition (meals, snacks, etc.)
14. Illness or temporary discomfort (headache, flu, hangover, motion sickness, dysentery, etc.)
15. Stimulants/depressants (drugs, alcohol, caffeine, etc.)
16. Motivational level (excessive or insufficient)
17. Mood (tension, anger, depression, get-homeitis, boredom, preoccupation with personal problems)
18. Self-discipline level (apprehension to panic)
    1. Maintaining cool/composure
    2. Attention
    3. Judgment
19. Overconfidence
    1. In own ability
    2. In others
    3. In vehicle, equipment or tool
20. Underconfidence
    1. In own ability
    2. In others
    3. In vehicle, equipment or tool

Inadequate Environmental States
21. Light (man-made or man-induced)
22. Light (natural, day, lightning)
23. Vision restricters (dark, haze, precipitation, exterior smoke, clouds, dust, glare, etc.)
24. Interior smoke, fumes or ventilation
25. Hail, icing, sleet, tornado, earthquake (other natural phenomena not vision restricting)
26. Temperature or density altitude
27. Altitude or oxygen
28. Sound or noise
    1. Internal (in earphones, in vehicle or in confined work area, etc.)
    2. External (outside vehicle or outside confined work area, etc.)
29. Geographic area
    1. Water (ocean, lakes, rivers, etc.)
    2. Terrain (jungle, desert, arctic, mountainous, etc.)
30. Wind, turbulence
    1. Natural
    2. Induced (rotorwash, etc.)
31. Vibration
32. Speed, acceleration, or deceleration

Inadequate State of Vehicle/Equipment Structure due to Production (from concept to manufacture)
33. Arrangement of components/parts (for operating, use)
34. Standardization (vehicle-to-vehicle)
35. Design (size, shape, anthropometry)
36. Manufacture (process or materials)
37. Legibility (readability)
38. Identification (marking, coding, etc.)
39. Accessibility (installing, removing, maintaining)
40. Lack of desired or state-of-art equipment (CWFS, radar, etc.)

Inadequate State of Vehicle/Equipment due to Maintenance
41. Scheduled inspection
    1. No provision for scheduled inspection or inadequate interval
    2. Not accomplished
42. Malfunction isolation or troubleshooting
43. Installation, removal, servicing
44. Repair, adjustment
45. Inspection of work completed (correctness, police of FOD, etc.)
46. Parts/equipment supply

Inadequate Facilities
47. Airfield/LZ
    1. Physical aspects (lighting, taxi lines, FOD, etc.)
    2. Personnel (tower operator, dispatcher, wx forecaster)
48. Flight planning/operations (charts, approach plates, NOTAMS, wx info, etc.)
49. POL
50. Medical (personnel, dispensary, equipment, supplies, etc.)
51. Overnight accommodations for transients (lodging, meals, etc.)
52. Navigational aids
53. Maintenance equipment/vehicle
54. Maintenance area
55. Crash rescue/emergency equipment or personnel
56. Unit supply (flight equipment, protective, life support)

Inadequate Written Procedures
57. This duty position/MOS
58. Other duty position/MOS
59. This phase of mission (preflight-to-after-action report)
60. This task/maneuver
61. This weather environment
62. This vehicle
63. This equipment/tool
64. This operational area (geographic or work/duty)

(57–64)
1. Not Clear
2. Incorrect
3. Incomplete

Inadequate Supervision or Coordination
65. Command
    1. This unit
    2. Other
66. Maintenance
    1. This unit
    2. Other
67. Operations
    1. This unit
    2. Other
68. Medical (other than facilities)
69. Armament/munitions
    1. This unit
    2. Other
70. Immediate level
    1. Flight leader, platoon leader, etc.
    2. Instructors/SIPs
    3. Crew or vehicle commander/supervisor
    4. Safety personnel
71. In-flight command/control
    1. This unit
    2. Other
72. Terminal guidance (pathfinder, ground guide, etc.)
    1. This unit
    2. Other

Inadequate Air Traffic Control
73. Flight following (unit, TOC, FOC, FSS, etc.)
74. Ground control/guidance (GCA, DEP control, center, etc.)
75. Tower

and the recommendations.

An example of better information. After reviewing more than 1,500 mishaps in which human error was a factor, USAAAVS analysts constructed a hypothetical example which is typical of many such accidents (table 4).

However, table 5 presents the narrative, findings and recommendations of this accident that USAAAVS could expect to receive.

TABLE 3
Remedial Measures

Reallocate this function/task/responsibility from this:

1. Duty position to another duty position
2. Duty position to a machine/device
3. Manually activated machine/device to an automatically activated machine/device

Redesign or provide to facilitate use by man

4. Controls
5. Instrumentation
6. Markings, decals, placards
7. Switches, knobs, dials
8. Work area, environment
9. Tools, job equipment
10. Basic vehicle
11. Major vehicle component
12. Protective equipment/clothing/life support equip
    1. Personnel
    2. Vehicle mounted
13. Organizational structure (informal or TOE, TDA)
14. Procedures for normal operation
15. Procedures for emergency or contingency operation
16. Checklists
17. Responsibility requirements
18. Training requirements
19. Qualification requirements (MOS, IP, slingload)

Modifiers (14–19)
1. TMs
2. FMs
3. ARs
4. SOPs
5. Directives

Modifiers (4–19)
a. Redesign
b. Provide

Improve monitoring of activities, missions, tasks, and compliance with procedures to increase/quicken error detection by:

20. Self monitoring
21. Crew or buddy system monitoring
22. Supervisory monitoring
    1. Unit commander
    2. Higher command
    3. Instructor/SIP
    4. Crew/vehicle commander/supervisor
    5. Operations, safety, others
    6. Flight surgeon
    7. Maintenance
23. Warning device monitoring

Inform others of errors detected, error consequences, and error remedies to increase sensitivity to problem areas in activities, missions, tasks or procedures by:

24. Work group briefings (oral or written) of same duty position/MOS/work group personnel
25. Individual counseling or briefing
26. Unit level briefings or meetings (safety, commander, etc.)
27. Wide distribution reporting (OHRs, EIRs, AVIATION DIGEST, etc.)

Provide timely and appropriate performance incentives

28. Encourage safe, efficient performance with praise, awards, promotions
29. Counsel "honest" mistakes with constructive discussion of remedies
30. Discourage flagrant or repeated unsafe performance with warnings and/or disciplinary action

When assigning personnel to any duty, mission or task, consider strengths and weaknesses of man assigned and manner in which assignment is made.

31. Training
    1. This duty position/MOS
    2. Other duty position/MOS
    3. Vehicle, equipment or tool
    4. Task/maneuver
    5. Environment (tactical, geographic, wx, night)

    Modifiers
    a. School
    b. Unit/OJT
32. Experience
    1. This duty position/MOS
    2. Other duty position/MOS
    3. Vehicle/equipment or tool
    4. Task/maneuver
    5. Environment (tactical, geographic, wx, night)

    Modifiers
    a. Recent
    b. Total
33. Psychological state
34. Physiological state

Develop, improve, upgrade, or provide unit/OJT and school training:

35. Determine training requirements by careful entrance interview of personnel
    1. School
    2. Unit/OJT
    3. Individual
36. Determine training requirements by periodic survey of qualifications of personnel in each duty position
    1. School
    2. Unit/OJT
    3. Individual
37. Develop sound programs where shortages of qualified personnel exist or are expected and carefully control MOS awarding
    1. School
    2. Unit/OJT
38. Do not attempt to OJT highly technical areas
39. Provide feedback to schools on acceptability/nonacceptability of school-trained personnel
40. Upgrade existing training programs to provide more emphasis, instruction or practice
    1. School
       a. Task/maneuver
       b. Vehicle, equip, tool
       c. Environment (operational or atmospheric)
    2. OJT/unit
       a. Task/maneuver
       b. Vehicle, equip, tool
       c. Environment (operational or atmospheric)
41. Provide for schooling opportunities to insure proper qualification and proficiency of assigned personnel
    1. School
    2. Unit/OJT

TABLE 4
Example of a Human-Error Accident: What Really Happened

At 1500 hours on 2 March 1974, Operations Officer posted an attack helicopter mission in support of a field training exercise (FTX) to be held the following day. However, he incorrectly posted 0830 as the takeoff time instead of 0730. He made this mistake because he was constantly too busy personally scheduling and coordinating all missions in addition to his other duties. He was "spread too thin" because operations was undermanned (the assistant operations officer was also the battalion instrument examiner). The negative impact of this situation on operations efficiency was not recognized by Unit Commander because he did not personally monitor operations and considered undermanning reports by staff officers as "empire building" or excuses to "cover up."

At 1830 hours, Pilot entered operations after an all-day mission to check the next day's schedule. He noted his 0830 FTX mission for the next day but was unable to get a mission briefing because Operations Officer was in a unit staff meeting and Clerk said it would go "on and on."

At 0800 hours on 3 March 1974, Pilot and Copilot completed preflight of AH-1G, SN 6900000, and proceeded to operations for the mission briefing they missed last night. Pilot had instructed Crew Chief to close and secure the inspection panels and cowlings. Crew Chief was about to secure the last of these (left-side engine and transmission cowling) when Platoon Sergeant asked him to get an auxiliary power unit (APU) and start another aircraft down the line ASAP. Thinking he would return prior to takeoff, or at least the pilots would finish securing during the final walkaround inspection, Crew Chief departed to get the APU.

At 0805 hours, Pilot and Copilot entered operations and approached Operations Officer who was on the phone. As soon as Operations Officer saw Pilot and Copilot, he put his hand over the phone and told them a mistake had been made in their takeoff time. He gave them a mission sheet with the correct takeoff time, coordinates and a contact radio frequency. He told them the CO was "having a fit" on the phone because Battalion had been "bad mouthed" by high-level Ground Commander whose FTX was being held up.

Thinking they would get the mixup straightened out when they returned, Pilot and Copilot ran back to the flight line, intent only in getting airborne. When they arrived at the aircraft, Pilot handed the mission sheet to Copilot and said he would crank the aircraft while Copilot plotted the coordinates and planned navigation. Caught up in the urgency of the situation and thinking of the map work ahead, Copilot gave his side of the aircraft a quick look as he climbed in. He either did not see the open latches on the transmission and engine cowling or they just did not register in his mind. Pilot saw the rotor was clear and untied, glanced down his side of the aircraft and, thinking everything was O.K., got into the cockpit.

At 0811 hours Pilot began starting procedures without a fireguard because no one was immediately available and time was essential. They hurried through the runup and were cleared into position for immediate departure. On climbout, at about 150 feet and 40 knots, the left-side engine cowling opened, broke loose and struck the tail boom, vertical fin and tail rotor, causing separation of the 90-degree gearbox. The pilots heard the noise and felt a shudder, and the aircraft yawed to the right. Pilot immediately entered autorotation and elected to land on the remaining runway. At about 20 feet, Pilot increased collective to check the rate of descent and simultaneously reduced throttle to establish alignment for touchdown. These coordinated throttle and collective actions failed to align the aircraft with the path of flight. The aircraft touched down in a level attitude at 5-8 knots of ground speed with a 60-degree right yaw. After touchdown, the left skid dug in, the cross tube collapsed and the aircraft rolled on its left side, sustaining major damage. Pilot closed the fuel and electrical switches and both pilots exited the aircraft uninjured and unassisted. There was no postcrash fire.

TABLE 5
Example of Human-Error Accident: Information USAAAVS Would Probably Receive

Narrative

At 0800 hours on 3 March 1974, Pilot and Copilot completed preflight of AH-1G, SN 6900000, and went to operations for a mission briefing while Crew Chief closed the cowlings. At operations they discovered a mistake in their takeoff time. Takeoff should have been at 0730 hours.

Pilot and Copilot rushed back to flight line, and, because Crew Chief was not there and time was short, cranked without a fireguard. They hurried through the runup and, at 0815, were cleared into position for immediate departure.

At about 150 feet on climbout, the left-side engine cowling tore loose and struck the tail rotor, causing separation of the 90-degree gearbox. Due to the low airspeed, Pilot entered autorotation to counter the nose-right condition. On touchdown, the aircraft rolled over on its left side, causing major damage. The crew sustained no injuries and exited the aircraft unassisted. There was no postcrash fire.

Findings

1. Pilot failed to comply with preflight checklist.
2. Pilot failed to post fireguard in accordance with starting procedures outlined in -10 checklist.
3. Pilot allowed aircraft to touch down with excessive forward motion for the right-yaw condition.

Recommendations

1. Recommend pilots follow prescribed preflight and starting procedures and that these topics be made the subject of the next monthly safety meeting.
2. Recommend Pilot receive postaccident checkride with emphasis on simulated antitorque failure maneuvers.
3. Recommend the facts and circumstances surrounding this mishap receive widest dissemination.

This is the typical "everybody-is-clean-except-the-pilot" accident report.

By contrast, table 6 presents an analysis of table 4 information that identifies what happened, why it happened and what can be done about it. This analysis was completed by using tables 1, 2 and 3 and following the "how-to-do-it" steps outlined above. It should be noted that job performances of the unit commander, operations officer and crew chief contributed to the pilot's task error. Therefore, human-error analyses (table 6) were performed on the role of each of these duty positions but are not presented because of space limitations.

From this analytic example, it should be obvious that "pilot-error accidents aren't all pilot," that accident boards can generate and report quality information and that something can indeed be done about "pilot-error" accidents. The objective in requiring full and complete accident information is not to single out any one individual. The objective is to help fulfill Army aviation's responsibility for maximum possible efficiency by squeezing out of each accident all information that can be used to increase proficiency at each duty position.

TABLE 6
Example of a Human-Error Accident: Information USAAAVS Should Receive

Name	SSAN	Duty
Buck Pilot	000-00-0000	P

Item	Code	Explanation
Task	11.1	Insure complete preflight inspection performed on AH-1G helicopter.
Error	4.d.1	Performed task inadequately: did not insure left-side engine and transmission cowling was secured prior to flight.
Inadequacy	67.1	Operations Officer assigned the mission in an angry, urgent manner.
Remedy	33	In making assignments, it should be kept in mind that the manner in which the assignment is made can affect the chances for a mission to be successful. Operations Officer should have told Pilot there had been a mistake in scheduling the takeoff time. To preclude any more mistakes, he should have stressed the need for Pilot to take the necessary time, even though the mission was already late, to insure that the aircraft was ready for flight and that he understood the mission before takeoff.
Inadequacy	18.3	Pilot allowed urgency imposed on him by operations to cloud his judgment: he did not inspect (trusted that Crew Chief had closed and secured as instructed) and cranked without a fireguard.
Remedy	20	When faced with unusual/urgent situations, pilots must remind themselves to follow sound, established procedures. In those rare emergencies where established procedures must be compromised, pilots must carefully evaluate the alternatives and associated risks when selecting a course of action.
	40.1.C	Schools should emphasize to pilots that operation urgency can be as catastrophic as in-flight emergency and train to follow sound accepted procedures in the face of both.
Inadequacy	67.1	Operations Officer posted incorrect takeoff time because he was too busy to be efficient. He personally scheduled and coordinated all missions in addition to his other duties because operations was undermanned.
Remedy	22.1	Unit Commander should personally monitor unit personnel. Personal monitoring of operations personnel would have revealed impact that assigning assistant operations officer as battalion instrument examiner had on efficiency of operations.
	26	Through unit level briefings, Unit Commander should assure his staff officers that he has an "open door policy" concerning operational difficulties and that each problem will receive his personal attention according to priority.

COMMENTS

From gearbox separation until the aircraft finally came to rest, it was found that Pilot's reactions to this emergency were proper and in accordance with the -10 instructions for this situation: (1) Touchdown should be executed in as level an attitude as can be achieved, and (2) ground speed should be as low as possible to minimize the possibility of turnover.

COMING SOON!
DOWN TO EARTH-

COLOSSAL! . . . Stupendous! Authentic! . . . Movie of the year—no—of the century . . . Extremely informative . . . A most professional treatment of a most important subject . . . These are just a few of the ways movie critics might describe the most recent training film produced by the U. S. Army Agency for Aviation Safety (USAAAVS). And why not? The subject is probably the "hottest" one to be dealt with in 25 years, and one that is fraught with danger if it is not taken seriously and thorough planning and preparation made for all phases of training. This 45-minute color film covers it all—from NOE (nap-of-the-earth) planning, briefing, preflighting and navigation, all the way through operational checks, limitations, hazards, techniques, emergency procedures, and much, much more.

But what makes this film truly outstanding, however, is not merely the subject matter—important as it may be—but the vast display of professionalism in all areas of production. For the majority of the scenes, which were filmed in the state of Washington, consider the cast: one professional actor, one technical advisor from USAAAVS and Army IPs (instructor pilots) assigned to Fort Lewis—IPs who are currently conducting training at the Yakima Firing Center over some of the most rugged terrain found anywhere. Similarly, those scenes filmed at the Fort Rucker reservation employed IPs assigned to the Army Aviation Center. With

Movie crewmen begin to arrive as aircraft is readied for morning filming session. Below, sample of terrain overflown en route to "shooting" locale

Ted Kontos
Publications and Graphics Division
U. S. Army Agency for Aviation Safety

USAAAVS

-NOE

Huey crosses ravine before landing to unload camera equipment and crews. Camera is set up on edge of precipice overlooking ravine

the exception of the professional actor, the cast consists of some of the most knowledgeable people associated with NOE flight. They have the experience, know the problems involved and most important, have the answers. The film tells it all in a thoroughly realistic and convincing manner.

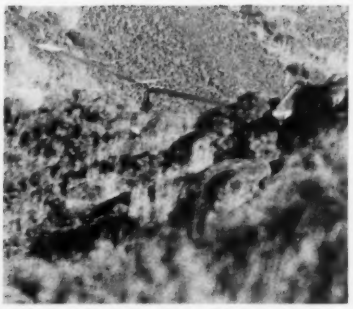
Kudos to all the pilots, maintenance personnel, technical advisor, professional actor, director and movie and supporting crews for a job well done. Without resorting to superlatives, we will simply say this is one film you will want to see again and again. Look for it at your film library around April 1975.

Aviation Safety Films Currently Available Through Audio-Visual Support Center

TF 46-3105—Flight Line Safety (Color—20 min—1962)—Teaches Army aircraft mechanics the rules and procedures to prevent accidents when performing maintenance tasks in the service area.

TF 46-3374—And He Filed VFR (Aviation Safety) (B&W—21 min —1964)— Details of an aircraft accident. Stresses need for profi-

Camera and "actor" eye each other while waiting for sun to rise and illuminate ravine. With aircraft perched atop pinnacle, pilots take break



As camera rolls, main rotor pops into view . . .

ciency in instrument flight through practice and study.

TF 46-3399—A Form, A Red X and You (B&W—16 min—1964)—How failure of two aviation mechanics to red X repaired aircraft for proper inspection before return to service resulted in accidents.

TF 46-3455—Lessons Learned From Aircraft Accidents—Fuel Exhaustion (B&W—15 min—1964)—Danger of inadequate fuel monitoring and flying with a low fuel level; how aviators can avoid fuel exhaustion accidents.

TF 46-3470—Lessons Learned From Aircraft Accidents—Postcrash Survival (B&W—25 min—1964)—How urgency of mission, hypoxia and stress contribute to accidents, and how aviators can recognize and cope with these factors.

TF 46-3488—Lessons Learned From Aircraft Accidents—Emotions (B&W—16 min—1964)—How emotional problems may interfere with efficiency, how to recognize them and what to do about them to prevent aircraft accidents.

TF 46-3673—Helicopter Icing (B&W—28 min—1966)—How and when ice forms on aircraft, how to deal with potential icing situations and how ice affects helicopter components and helicopter flight.

. . . and Huey makes itself visible from behind rock ledge

Huey returns to pick up crew and head to new location. Home again, aircraft is prepared for other scenes to be filmed. Outdoor scenes not necessitating flight are then completed

TF 46-3681—Safety Procedures in Refueling Army Aircraft (Color—23 min—1966)—Conditions that cause refueling hazards of contamination and fire, and safety measures to avoid these dangers.

Moving to indoor set, cameraman takes lightmeter reading

With actors in position, camera records briefing session

TF 46-3768—Lessons Learned From Aircraft Accidents—Know Your Aircraft (B&W—21 min—1967)—Actual cases point up the aerodynamic and psychological factors which contribute to overgross accidents and those due to unreported mechanical overstress.

TF 46-3797—The Minute Saved (Aircraft Safety) (B&W—29 min—1967)—Three actual Army aircraft accidents selected from the files of USAAAVS point out to aviators how each accident was basically caused by hasty action mixed with thoughtlessness under the pressure of circumstances.

TF 46-3822—Foreign Object Damage to Army Aircraft (B&W—16 min—1967)—How foreign object damage is caused in Army rotary and fixed wing aircraft, and how it can be prevented before, during and after flight; particular emphasis on good housekeeping at air bases and proper flight techniques at sandy and rural areas.

TF 46-4365—The Quarter Million Dollar Tip (Aircraft Maintenance) (Color—8 min—1971)—Points up the importance of careful aircraft maintenance by showing a helicopter crash caused by the broken tip of a screwdriver left in a gear by a careless mechanic.

TF 46-4366—Why Fly High (Color—3 min—1971)—Describes the dangers of unnecessary low-level flying, such as powerlines, large birds and the difficulty of finding emergency landing places.

TF 46-4418—Lessons Learned From Aircraft Accidents—Dress to Live (Color—17 min—1971)—Graphically demonstrates the importance of wearing proper clothing while flying. Describes purpose and usefulness of each item of clothing required.

TF 46-4532—Aircraft Ground Safety Training (Color—24 min—1973)—Demonstrates safety precautions to follow when working around aircraft with engines running; entering and leaving; sling loading; refueling and guiding. Shows protective clothing.

TF 46-4692—Aircraft Accident Investigation (Color—32 min—1974)—Using an actual crash, this film depicts the duties and functions of an accident investigation board.

TF 46-4706—The Aviation Safety Officer (Color—28 min—1973)—Gives an overview of the role, duties and responsibilities of the aviation

safety officer in running a safety program, including surveys, drills and education.

TF 46-4712—Aviation Maintenance Safety: Your Responsibility (Color—22 min—1974)—Shows how to create a safe working environment while doing a quality job on aircraft maintenance. Safety practices are shown, emphasizing how to do it right.

TF 46-4730—Aircraft Management Surveys (Color—20 min—1974)—Depicts an actual survey and the use of the USAAAVS Guide to Aviation Resources Management for Aircraft Mishap Prevention.

MF 46-5290—A Night on Jackrabbit Mesa (Aircraft Accident Rescue Procedures) (Color—23 min—1968) (Adopted Air Force film)—Describes the role of civil authorities at the scene of a military aircraft accident, showing how the coordinated efforts of local law enforcement, fire and medical agencies are required in disaster rescue operations.

MF 46-5306—The Will to Live (Aviation Safety) (B&W—50 min—2 reels—1968)—A lecture by Brigadier General W. W. Spruance, assistant adjutant, Delaware Air National Guard, on aviation safety.

MF 46-5527—Foreign Object Damage Prevention-Turbine Engines (Color—23 min—1969)—Explains the FOD turbine engine problem, and delineates the maintenance measures to prevent aircraft FOD. Concept, organization and functioning of FOD teams in Vietnam are described to emphasize the need for unit participation in the FOD prevention program.

MF 46-9029—Helicopter Arctic Operations (Color—29 min—1959)—Planning, technique and procedure for safe helicopter operations. Includes preflight inspection, takeoff and landing in normal and emergency operations, and unloading and fueling procedures.

The day's filming completed, crewmen install Continental mount in Huey for air-to-air shots to be filmed

Shifting to Ft. Rucker, Cobra gets ready to make pass

Director watches as cameraman frames in on aircraft and assistant records scene. Cobra moves in and pulls up before turning around, then heads back among trees

"DON'T DO THIS!" or "DON'T DO THAT!"

CW3 Pierre R. Lefebvre
Aviation Safety Officer
Fifth U. S. Army Flight Detachment

HOW MANY TIMES have you sat in a safety meeting and heard a "Don't do this!" or "Don't do that!" approach to aviation safety? How many times have you seen someone given a pat on the back for doing something positive about safety? Granted, if a man needs a don't, then he should get it. But he should also be recognized for "doing it right."

The Fifth U. S. Army Flight Detachment, Randolph Air Force Base, TX, has taken a positive attitude toward aviation safety. We are patting our aviators on the back by giving them individual safety awards for accident-free flying hours. We went beyond the DA Form 1119 (U. S. Army Safety Award) because we felt that someone with 3,000 to 7,000 hours of accident-free flying time deserved more.

Here's how we did it. First we had to find out the total accident-free flying time of each assigned aviator. Accident-free flying time started at zero after a major or minor accident was charged to the individual (i.e., when instructor pilot or pilot was determined as the definite cause when that individual was filling that slot). If an individual had never had an accident, his total time was used. The accident-free flying hours for each individual were rounded down to the nearest 100 hours. This was done so no one would receive an award for flight time he had not yet flown.

Here's what we did.

- We gave each individual a Certificate of Achievement for accident-free flying hours.
- We gave each individual a DA Form 1119.
- We requested the commanding general present the awards.
- We arranged for as much PIO and press support as we could get.

Sure, it was a lot of work, but it was worth it. You see, my fellow aviators were proud of their accomplishments and it showed when they received their awards.

While researching data for these awards, we discovered some rather interesting facts about our unit.

- Total number of individual accident-free flying hours: 57,700.
- Average accident-free flying hours per aviator: 3,205.
- Total hours of instructor pilot time: 10,153.
- Total hours of combat flying time: 18,438.
- Total number of instructor pilot and instrument flight examiner qualifications: 47.

USAAAVS extends a well done to the men of the Fifth Army Flight Detachment for their fine record and positive approach to aviation safety.

If you have a question about personal equipment or rescue/survival gear, write Pearl, USAAAVS, Ft. Rucker, AL 36360

PHOTO © PLAYBOY

PEARL'S

Personal Equipment & Rescue/Survival Lowdown

Overwater Equipment

Please furnish information regarding the correct aircrewmembers' overwater equipment that should be on hand for TOE and TDA units. The aviators in our unit fly both rotary and fixed wing aircraft.

Paragraph 3-35, page 3-7, Army Regulation 95-1, dated December 1973, requires aircraft on extended flight over bodies of water where forced landings on land cannot be negotiated be equipped with sufficient lifevests, liferafts and emergency survival equipment for each person aboard.

Common Table of Allowances (CTA) 50-900, dated 15 November 1973, prescribes allowances for organizational clothing and individual equipment authorized personnel of the Army components for procurement with appropriated funds. CTA 50-900 authorizes liferafts, life preservers and survival equipment.

Section VI, page 1-42, Technical Manual 55-1500-204-25/1, dated April 1970, with change 18 dated October 1973, establishes type and number of liferafts per aircraft. Inspection and maintenance of survival equipment is also covered in section VI.

SPH-4 Helmet For Seals

It is recommended that the earcups in the SPH-4 helmet be changed periodically. Usually they should be changed when they start to get hard. I need to know how my unit can obtain some replacement earcups. I am a safety officer with some experience in unit supply and realize the urgent need for them, plus the problems of getting them. Here is the crux. My unit is in Korea, and we have the checkbook supply system.

Two or three aviators in my unit are getting headaches from unserviceable earcups, and the earcups on my helmet are 2 years old and hard as the helmet itself. I have never been in a unit that has had replacement earcups.

I feel that the aviators in my unit (and possibly other units) should not have to suffer hearing loss because of a slow or nonexistent supply system with confused priorities.

Your comments regarding replacement and availability of the Seal, Plain, NSN 5330-00-143-8577, are correct. The product is managed by Defense Industrial Supply Center (DISC), Philadelphia, PA. The present stock is exhausted; however, a shipment is expected in the near future. When the shipment is received, DISC will fill requisitions based on priority designation. Some units have ordered the seals direct from Gentex Corporation, Carbondale, PA 18407. Time for delivery has been reported good and current price is $1.96 per pair.

HGU-7P Helmet

Our unit flies U-21/U-8F aircraft and one of our aviators has acquired a military airlift commander's helmet, flying, HGU-7P, NSN 8475-00-060-9222.

Could you please tell me what USAAAVS' feeling is about this helmet.

The helmet, flying, HGU-7P, designed for use in fixed wing aircraft with reduced landing speeds, is a U. S. Air Force item of issue to U. S. Air Force transport pilots. It provides minimum protection in the event of a crash. The helmet is a baseball batter's type protective helmet with a smoked snap-on visor and attached communication harness. The helmet comes in three sizes and is managed by the Defense Personnel Supply Center. The Air Force Life Support Equipment Systems Program Office indicated that the Air Force has limited quantities in stock.

USAAAVS does not recommend use of this helmet in lieu of the SPH-4. However, to procure the helmet, a DA Form 2028 must be submitted with justification through channels to have the item added to CTA 50-900. Upon approval and addition of the helmet to CTA 50-900, it could be requested through normal supply channels.

USAASO Sez

The U. S. Army Aeronautical Services Office discusses

Being a professional

Those small electronic calculator woes

The Professional Pro: Everyone associated with Army aviation must be a professional. However, an air traffic controller must be a professional professional. Crazy? No, not really. What other Army school has an MOS-producing course, graduation from which only gives the individual a license to train? Not until he is facility rated is the controller a professional controller. This is the reason that a nonfacility rated individual holding an air traffic control MOS cannot be considered as qualified nor can he be applied to the minimum manning level of an ATC facility.

The man with the mike must be a professional. To produce a professional air traffic controller, time and money are required—money to train him in the various complex skills required of the profession today and time to allow him to develop these skills. Simply completing a technical school does not automatically make the novice able to handle any ATC job that comes along. The controller's decisions must be made on split-second notice. Human lives and millions of dollars' worth of equipment depend on the correctness of these decisions. To place an inexperienced controller in a position for which his training and experience do not qualify him is to place a loaded pistol at his head (and the heads of all who are dependng on his proficiency). This pistol is cocked every time he picks up a microphone. It can be activated at any moment by the unseen hand of a misunderstood instruction or by a traffic load which is beyond his capabilities. The only answer to this situation is experience and knowledge—and this means time and training. Time and training are the elements of experience, and experience is the indispensable factor in producing the professional pro.

Calculator Interference: The October 1974 ATC Bulletin prepared by the U. S. Army Air Traffic Control Activity carried the following article: "Mini-Calculators Bad News".... According to the Canadian Ministry of Transport, recent tests have shown that the small electronic calculators which have recently flooded the market can interfere with ADF radio compasses. Of five calculators tested, two paralyzed the radio compass when held within 3 feet of the loop antenna. The others caused varying degrees of deflection of the radio compass needle. Naturally, interference is greatest when ADF station signals are weakest. These calculators, like FM receivers and tape recorders,contain an oscillator which generates and transmits a signal. The calculators produce interference in the 200 to 450 KHz band. However, it is also possible that harmonics of those frequencies could affect VHF and UHF equipment. Aircrews should avoid carrying those miniature transmitters or make sure they are switched off. They don't need to be operated to lead you astray. This warning should also be added to passenger briefings.

USAASO Sez–Calculate the problem but leave calculators at home!

LAST VIETNAM CLASS GRADUATES

The graduation of Vietnamese class 74-42 and 74-44 last December phased out the initial entry helicopter training program for Vietnamese Air Force officers at the U. S. Army Aviation Center Fort Rucker.

During the graduation ceremony, Major General William J. Maddox, Jr., commander of the Aviation Center, presented wings to Air Cadet Ta Rot, the last member of the final Vietnamese class. Cadet Rot was the leader of the class.

The training program for the Republic of Vietnam Air Force (VNAF) officers was curtailed as a result of funding cuts made by Congress. There were 162 graduated.

According to Captain Marion E. Edwards, officer-in-charge of the VNAF training, the first group of Vietnamese students for this initial entry program arrived at Fort Rucker October 25, 1973. New students stopped arriving in August 1974 when it was announced that the training was to end.

Hellfire

HELLFIRE FOLLOWUP

(see "HELLFIRE," by Colonel John B. Hanby Jr. in the January 1975 DIGEST)

Two air-to-surface missiles—launched a split second apart—scored direct hits on two tank targets in the first successful ripple fire demonstration of laser-guided weapons on 27 November 1974 at the U. S. Army Missile Command's Redstone Arsenal, Huntsville, AL.

Colonel John B. Hanby Jr., Army HELLFIRE project manager, said the perfectly executed test "demonstrates the feasibility of the HELLFIRE module system."

This impressive flight test of the Army laser seekers with their test missiles was described as the most demanding to date.

An Army crew flying an AH-1G Huey-Cobra first performed a "pop-up" maneuver, hovered at an altitude of 80 feet, then launched the first missile toward a tank illuminated by a ground-based laser locator designator (GLLD).

A quarter of a second later, the crew launched the second test missile at a second stationary tank situated about 20 meters from the first target. This tank was illuminated by a stabilized platform airborne laser (SPAL) aboard a second AH-1G helicopter.

Once launched, the missiles flew toward their individual targets and impacted almost simultaneously.

Only 2 weeks earlier, the Army scored direct hits with two laser-guided missiles fired 8 seconds apart in the first successful rapid fire launch against two tank targets illuminated by a single ground-based laser designator.

PEARL models the Heavy Flying Jacket with Attached Hood, NSN 8415-00-270-0364

COLD CLIMATE SURVIVAL KIT AND COMPONENTS

1. Fishing tackle kit, survival type, NSN 7810-00-558-2685
2. Knife, pocket, NSN 5110-00-162-2205
3. Mirror, emergency signaling, NSN 6350-00-261-9772
4. Wire, commercial brass, 20 ft., NSN 9525-00-596-3498
5. Spoon, picnic, plastic, NSN 7340-00-170-8374
6. Bag, storage, drinking water, NSN 8465-00-485-3034
7. Compass, magnetic, type MC-1, NSN 6605-00-515-5637
8. Food packets, survival (7), NSN 8970-00-082-5665
9. First aid kit, individual, NSN 6545-00-823-8165
10. Survival Manual, FM 21-76
11. Operator's Manual, TM 55-8465-212-10
12. Headnet, insect, NSN 8415-00-261-6630
13. Sleeping bag, type SRU-15/P, NSN 8465-00-753-3226
14. Poncho, lightweight with hood, NSN 8405-00-935-3257
15. Saw-knife-shovel assembly, hand, fingergrip, NSN 5110-00-733-7129
16. Pan, frying, NSN 7330-00-082-2398 (Packing slip also shown)
17. Matches, nonsafety, wood (3), NSN 9920-00-985-6891
18. Signal, smoke and illumination, NSN 1370-00-309-5028
19. Candles, illuminating (5), NSN 6260-00-840-5578
20. Box, match, plastic, waterproof, NSN 8465-00-265-4925
21. Fuel, compressed, ration heating (3), NSN 9110-00-263-9865
22. Case, survival kit, NSN 1680-00-082-2512
    Complete assembly, NSN 1680-00-973-1862

This is the sixth of 12 back covers designed to show personal survival, rescue and protective equipment. Detach this cover for your bulletin board display of the more important survival and protective equipment available to crewmembers.

6 USAAAVS OF 12